



Not quite the ‘death of the high street’ in UK city centres: Rising vacancy rates and the shift in property use richness and diversity

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ABSTRACT

This paper explores the inter-connections between property use diversity, change of use, and the adaptive capacity within urban retailing systems. The retailing centres of five UK case study cities, Edinburgh, Glasgow, Hull, Liverpool, and Nottingham, are examined over a twenty-year period using original databases on property use and geospatial mapping techniques to employ property use richness and diversity metrics in a novel manner. Overall, the analysis finds property use richness has generally risen as comparison retailing and financial services have contracted, to be replaced by hospitality, leisure, and residential uses. However, this re-balancing has not been even across retailing centres and is outstripped by rising vacancies. The study also reveals spatial variation in change of use and use diversity and richness as retailing centres slowly adapt, implying that future policy-making should focus on creating more resilient, mixed use city centres as an alternative to the single use retail high streets of the past.

1. Introduction

Urban retailing centres in the UK are experiencing unprecedented change. The effects of intensifying competition from out-of-town shopping and e-retailing since the early 2000s, and spiralling occupation costs are evidenced through increasing occupier business failures, vacancies, uncertainty and instability on the High Street. These structural changes (which have been accelerated by the Covid-19 pandemic) are shifting the focus of policy-makers charged with managing urban centres towards the promotion of more diverse property uses in areas once dominated by retail. This policy response was heavily influenced by the [2011 Portas Review](#) and has gained emphasis in the wake of the Covid-19 pandemic as rising vacancy levels are counter to the diverse, multi-functional and vibrant commercial and social hubs envisaged for short-term recovery and long-term sustainability ([Parliament. House of Lords, 2021](#)).

In parallel to the policy shift, the academic literature has seen the conceptualisation of retailing centres, for instance in the seminal work of [Wrigley and Dolega \(2011\)](#), as ‘economic eco-systems’ which are integrated into the local, regional, national and international economy and property market through a network of interdependences. This sector of the property market encapsulates perhaps the most diverse range of

stakeholders and influences of any sector: from the end user, ‘the consumer’, in all their guises and changing behavioral patterns; to occupiers and owners, ranging from local to international; to multiple layers of governance. The interests and aspirations of these stakeholders are multiple and complex, underpinning spatial outcomes that are often manifested in the physical form and heterogeneity, or lack thereof, in town and city centres. It is these forces that are shaping the functioning and performance of changing retailing centres and the increasing polarisation of fortunes evident within the UK’s retailing landscape.

The purpose of this paper is to document changes in property use within urban retailing centres while investigating the effects on centre-level diversity. This was undertaken using empirical case studies of five UK cities: Edinburgh, Glasgow, Hull, Liverpool, and Nottingham. The conceptual framework has its theoretical underpinnings rooted in complex systems theory ([Pennacchioli et al., 2014](#)), providing an evolutionary perspective ([Ramos-Martin, 2003](#)) to study how property occupiers and landlords have responded to their shifting, and often competitive, environment.

The research presented is novel in two ways. First, it reconsiders use change and diversity as part of a retailing system, both of which are essential for maintaining and enhancing vitality and viability. This is achieved through the modification of established ecological metrics:

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richness, the Gini-Simpson index of diversity and Shannon's equitability index, which are used as tools to monitor the diversity of urban property use at different scalar levels of analysis. These metrics have been utilised before in land use studies to examine landscape diversity and urban density (e.g. Tsai, 2005; Velázquez et al., 2018) but not to investigate the spatial heterogeneity of property use in urban retailing centres.

Second, it links administrative and commercial datasets in a manner not previously attempted. This has allowed the creation of extensive spatio-temporal stock databases enabling the study of evolutionary change in five UK cities over the last two decades (2000–2017). These theoretical and methodological developments allow scrutiny of the variation in property use and use diversity within urban retailing centres. Finally, the paper reflects on how the findings can inform future interventions to help address the current challenges facing urban retailing centres.

2. Adaptive resilience within retailing systems

Retail markets are spatial economic systems, consisting of organisations and institutions that can reorganise their form and function to adapt to external and internal destabilising shocks. Wrigley and Dolega (2011) draw from complex theory to conceptualise these centres as dynamic urban systems that exhibit 'adaptive resilience' (Martin, 2012) as they evolve, grow and adapt in a continuous process of anticipatory or reactive change. Dobson (2015) argues, however, that 'transition' better explains what is happening on the High Street. His view draws on the notion that transition is forward-looking and places emphasis on the shift from one state to a new state. In an adaptively resilient retailing system the emphasis, embracing the sentiment of Dobson's argument, is on evolving to a new stage where fresh social, economic and ecological relations are defined. Severe exogenous shocks, such as the disruptive influence of new technology or a global pandemic, may trigger the demise of some retailing organisations and functions, opening the way for new opportunities, innovation and change within the urban retailing centre (Jones & Livingstone, 2018). Innovation and novelty are products of the competitive, predatory or mutualistic interactions between local retailers and other stakeholders which can result in the development of new retailing formats and alternative uses for land and existing buildings (Allen, 2001).

Agglomeration economies and associated effects emerge not only from market forces and policies within the system but also from non-market interactions and networks. Such forces of attraction give rise to some retail uses, for example women's clothing, unisex clothing stores, jewellery and fashion accessories, tending to form clusters within the city centre (Eckert et al., 2013). Different stakeholders and sub-localities will be organised differently and linked into different interdependences, flows and structures. Subsequently, urban retailing centres display different responses and levels of resilience to shock. Martin and Sunley (2015) dissect the variation in urban resilience into two effects which they relate to local economic diversity. The first effect is where lower specialisation in the economic activities within an urban retailing centre results in it being less vulnerable to sector-specific shocks – a "portfolio effect" (p. 27). The second effect they call the "innovation and market opportunity effect" (p. 27), and argue that it gives rise to differential recovery rates if a shock occurs. Greater economic variety, combined with heterogeneous interdependences, results in greater innovation and opportunities to reorientate the economy and drive a more rapid recovery (Martin & Sunley, 2015). Hence, the more heterogeneous an urban retailing centre, i.e. the greater property use mix there is, the higher its resilience to economic change (Capello et al., 2015). This heterogeneity is determined by a range of factors, including the size and diversity of its functions, the quality of its infrastructure

provision, the density of linkages with external labour, manufacturing and distribution markets, and occurrence of co-operation networks that exist within the economy. Together, this complex array of economic and social factors interact to create urban retailing centres with variable capacity to anticipate, react and reorganise, thereby evolving at different rates across the UK to create new configurations, interdependences and further heterogeneity (Wrigley & Dolega, 2011). An urban retailing centre's adaptive capacity is linked to the heterogeneity of individuals and organisations who use, occupy and own retailing properties and their form and response to change. It also determines a system's ability to change within its existing path of development (adaptation) or develop multiple new development path trajectories (adaptability) (Boschma, 2015).

3. Diversity of property use

The resilience of urban centres is closely linked to the related land use planning concepts of vitality and viability (Ravenscroft, 2000). These concepts are well-established and captured by national planning guidance published in England and Scotland over the last three decades. Vitality describes the level of activity in an urban retailing centre at different times of day, and viability refers to the ability to attract investment by landowners and occupiers (URBED & Comedia, 1994), which, in turn, are linked to the heterogeneity within urban retailing centres. Dolega and Celińska-Janowicz (2015) interweave vitality and viability to develop a dynamic theoretical framework of retail resilience where *growth*, *consolidation*, *release*, and *reorientation* represent four development phases within the adaptive cycle of a retailing centre. The degree of vitality and viability demonstrated by an individual retail centre is dependent on its position within this adaptive cycle.

During the *growth* phase, Dolega and Celińska-Janowicz surmise both the vitality and viability of urban retailing centres increase. This stage is characterised by innovation and a high rate of new stores opening which leads to greater diversity in retailing provision and services, greater competition and high turnover of retail space, until eventually maturity is reached. As growth slows, possibly due to development constraints limiting further development activities and/or shoppers avoiding congested city centre locations in favour of more convenient car-friendly out-of-town developments (Teale, 2012), urban retailing centres enter a period of *consolidation*, vacancy rates fall and retailing centres reach their highest capacity to adapt as vitality and viability peak. Eventually, their ability to adapt to change diminishes as individuals and organisations become increasingly entrenched and reluctant to alter their behaviour due to associated rising costs (Crespo et al., 2014). The result is that resiliency reduces, leaving urban retailing centres vulnerable to the risks associated with retail decline.

The *release* phase is usually triggered by a sudden unexpected disturbance, typically associated with greater uncertainty and a surge in the rate of shop closures and worsening of a retailing area's vitality and viability. Triggers could be the development of a competing shopping centre (Guy, 1999), a change in government policy or taxation that reduces the viability of the traditional retailing model, or a sudden international economic shock that impacts negatively on the level and pattern of consumer spending. These changes also open up new possibilities and a process of 'creative destruction', as explained by Schumpeter (1942), begins. Innovative entries to the system emerge as disruptive forces erode, if not destroy, the value of established and stagnated retail and service configurations, resulting in a release of the centre from its rigid trajectory. At this point, innovation and creativity take hold and the retailing centre enters the *reorientation* phase. New configurations in accommodation and use of space emerge through internal mechanisms of change and urban renewal, creating new

interdependencies and social structures. These innovations, possibly nurtured by institutional support, draw footfall which increasingly provides new potential for growth, stimulates further innovation and increases vitality as the centre enters a new phase of growth. Examples of innovations adopted by physical retailers in response to the intensifying competition from more cost effective online retailers have included showrooming, greater use of technology to streamline the distribution chain and improve the customer's experience, the use of social media to market and promote brands, and the creation of experiential in-store events.

This adaptive resilience complements, at least in part, an evolutionary economics perspective, where transformational change is primarily a product of evolution rather than 'rational intention' (Dopfer et al., 2004). While reactive and anticipatory responses underpin an adaptive system, there are gaps, as highlighted by Dolega and Celińska-Janowicz (2015), in our understanding of the specific internal mechanisms that determine the capacity of retailing centres to change. Evolutionary mechanisms, such as selection and replication, self-organisation and variation and diversity, might offer some explanation of these internal adaptation mechanisms and how they differ across space within a retailing ecosystem.

Selection, for example, is evident when disruptions occur and property users who fail to adapt to changing competitive pressures do not survive. Failure to integrate online sales, physical stores and other sale platforms into omni-channel retailing is one example of a selective pressure that has forced some retailers out of the market. Retailing may have traditionally dominated the High Street, but we have recently seen a rise in retailer failure rates and new property uses emerging due to a shift in selective pressures. It is innovation in new property uses that drive the variation in use between and within centres, and essential in the reorientation and recovery of a urban retailing centre (Dolega & Celińska-Janowicz, 2015). Recent innovations have seen the development of new retail configurations (Carmona, 2021; Jones & Livingstone, 2018) such as pop-ups, in-store micro shops, the rise of experiential retailing, and new retail and non-retail mix combinations. Although there are spatial variations within and across centres, these retail re-configurations and new structures are quickly replicated and stand as examples of innovation diffusion theorised by Rogers (2003).

To synthesise the discussion, greater variety in retailers and uses seems to be especially important to the resilience of retailing centres. The findings of Wrigley and Dolega (2011) complement this view. In their study they develop a multivariate panel model to explain the resistance and recovery of retail centres between 2006 and 2009, and reveal why some centres appear to be more successful in adapting than others. They model 267 geographically diverse centres, spanning the retail hierarchy, and found retail centres that contained a diverse mix of shops, represented by the proportion of small independent retailers, the presence of newly-established supermarkets and a lower percentage of retail to service units, were less likely to have retail vacancies and more resilient to the economic downturn in 2008. Yet, the homogenous mix of national and international retailers that tends to be repeated across the prime 'cloned' retail pitches of the more resilient, top performing retail centres (GENECON, 2011) contradicts Wrigley and Dolega's (2011) finding that retail centre success relies on diversity and the presence of independent retailers.

Diversity within centres is not just about rebalancing the retail/service mix to changes in consumer preferences, it is also about introducing alternative uses. Variety can exist in property ownership, building formats and unit sizes, all of which are shaped by local factors such as vacancy rates, pedestrian accessibility, and the form and quality of the physical built environment. However, greater diversity is not without negative repercussions. One consequence of changing retail outlets to non-retail use is that it can give rise to so-called 'dead frontages' which fragment the High Street and degrade its urban design. Reimers and Clulow (2004) argue that the resultant dispersal of other nearby stores increases the time and physical effort involved in shopping, reducing the

likelihood of both impulse buying and comparison shopping. Despite evidence of such fragmentation in retailing in other countries (see Nyström & Folke, 2001) and recognition of the need to rebalance the mix of uses in UK retailing centres, use diversity at the micro-level in the UK remains under-researched as does the inter-connections between use diversity, change of use and the adaptive capacity within retail systems – despite the clear implications for resilience.

4. Measuring use diversity within an urban retailing system

The role of diversity, as discussed, is widely recognised as important in a complex system such as a retailing area (Capello et al., 2015). In this context, heterogeneity is perceived as a consequence of self-organisation and as a fundamental requisite to achieving a higher rate of adaptability. Defining and measuring diversity in retailing studies has taken different forms, with town centre health indicators established to measure vitality and viability. These have tended to associate diversity with mix of uses, including the representation of various retailers, concentration of service provision and vacancy rates as well as pedestrian flows, prime rental values, commercial yields and accessibility. The simplest, and probably most common, measure has been to count the number of different retail uses present, with variants including the number of retailers or total amount of floorspace occupied by different types of retailers, typically disaggregated into shopping trip purpose or broad property use categories. URBED and Comedia (1994), for example, recommend the number and variety of different retail and leisure uses as measures of vitality, frequently used to gauge the health of an urban centre or performance of a shopping mall.

Understandings of diversity and associated measures stem from ecology. While the nature of what is being studied differs, the ecological concept of diversity and techniques for measuring diversity are instructive. Ecologists would take issue, however, with using the number of different retail uses as a measure of diversity, instead they would refer to this as "richness". Richness is thus an indicator of the number of uses (or species in ecology). Although this can be a useful metric it does not take into account their relative abundance. A better measure would therefore include the proportional representation of different uses, for example, the proportions of value, premium/luxury and 'undesirable' retailing used to create both the HDH vitality indices¹ (2014, 2017 and 2019) as well as Wrigley and Dolega's (2011) use of the proportion of independent retailers as a measure of diversity in their vacancy-rate change model. However, this approach does not offer a comparable measure of diversity as it disguises whether a retailing centre has, for example, ten equally abundant retail and leisure uses, or if one of those ten accounts for the majority of space, with the latter arguably less diverse. Peet (1974) argued that a true measure of species heterogeneity is one that captures both richness and evenness. This study thus employs measures of both diversity and richness.

Two indices frequently used together to measure diversity are the Simpson index and Shannon index. Richness feeds into these when simply understood as the total number of different types of species in a community (in this case the number of different property use categories) (R). Simpson's (1949) index was devised to measure the degree of concentration when individuals are classified into types of species. A precursor developed by Hirschman (1945) – the Herfindahl-Hirschman index (HHI) – was devised to measure market concentration, providing a precedent for the current study. If the Simpson index (D) is adapted to a retailing system, it can be measured as:

¹ HDH Vitality Indices are published biennially by Harper Dennis Hobbs as measures of 'retail health' of 1000 high streets across Great Britain. The variables used to measure the health of these centres change across indices but typically include the vacancy rate, size of retail offering and local socio-demographic characteristics.

$$D = \sum_{i=1}^R \left(\frac{n_i}{N} \right)^2 \quad (1)$$

where n_i is the number of retailers or operators within use classification i in a retailing market and N is the total number of retailers or operators and R , richness, represents the total number of different types of use categories. The value of D generated by Eq. (1) lies between 0 and 1 but the larger the value of D , the lower the diversity. This is counter-intuitive and can be adapted into the Gini-Simpson index (Jost, 2006) so that the greater the value, the greater the sample diversity:

$$1 - D = 1 - \left[\sum_{i=1}^R \left(\frac{n_i}{N} \right)^2 \right] \quad (2)$$

Shannon's diversity index (H) also accounts for both abundance and evenness of the species present, but can be modified to allow evenness to be singled out. This means that Shannon's equitability index (E_H) is commonly employed alongside other diversity indices and can be calculated as:

$$E_H = \frac{H}{\ln R} = \frac{-\sum_{i=1}^R \left(\frac{n_i}{N} \right) \cdot \ln \left(\frac{n_i}{N} \right)}{\ln R} \quad (3)$$

Equitability assumes a value between 0 and 1, with 1 being complete balance in the uses present, although perfect use balance is not necessary desirable. Using these measures together offers a comprehensive way to evaluate difference in diversity between the case study retailing areas and overcome sensitivity to sample size, which is a drawback of using the Shannon index alone. Using approaches like this to examine use diversity are not unheard of, for instance, Ritsema van Eck and Koomen (2008) proposed the use of these measures as planning policy tools to monitor land use changes; Tsai (2005) uses the Shannon index to examine population and employment density while Velázquez et al. (2018) use it to measure landscape diversity. Yuo et al. (2004) also employ the Herfindahl–Hirschman variant of the Simpson index to measure the tenant mix within regional shopping malls. Yet, there are no published applications of these measures to investigate the heterogeneity of property use in urban retailing centres. Crucially, a blended use of measures also enables a consistent and comparable approach to estimate shifts in diversity over time, reflecting the focus on the evolution of use and diversity in this study.

5. Research methods and data

5.1. Case study selection

This paper, as part of a larger study designed to explore and explain the adaptability of the real estate market in five major UK retailing

Table 1
Size of case study retailing areas in 2017.^{a,b}

Retail centre	Case study retail area			Town centre change in floorspace 2000–2017
	Total floorspace m ²	Retail floorspace m ²	Number of retail units	
Edinburgh	274,997	136,195	472	−9.5 %
Glasgow	608,421	255,940	1123	8.3 %
Hull	336,466	194,296	489	20.6 %
Liverpool	510,246	369,627	784	62.7 %
Nottingham	526,588	302,984	950	5.2 %

^a Case study Floorspace data taken from Orr et al. (2022) and estimated using VOA/SAA. These do not include measurements for going-concern properties, such as Public Houses or St James Centre which closed for redevelopment in 2016.

^b The change in town centre floorspace is estimated using data from PMA (2021).

centre case studies, investigates changes in use diversity in Edinburgh, Glasgow, Hull, Liverpool and Nottingham over a period spanning 2000 to 2017. The focus on cities reflects the pre-dominant focus of private sector investor activity. And, while geographical diversity is purposefully included, the northern UK sample avoids the additional complexity of the north-south economic, social and political effects identified by Wrigley and Dolega (2011) as influential on the resilience of retailing centres and suggested to underpin differences in market operation (Hoesli & MacGregor, 1995; Jackson, 2001).

The chosen case study city centres are all regional significant centres at the apex of their local retail hierarchy, and have experienced a mix of fortunes which further underpins the rationale for their selection. At times their retail market performances have contrasted but have shown similarities at others. Furthermore, while some centres have stayed largely stable others have swapped places in the various retail index rankings.² There are also both similarities and differences in their catchments, expenditure, supply, competition and market fundamentals (see Schiller & Jarrett, 1985; Reynolds & Schiller, 1992; Hillier Parker, 1996; Harper Dennis Hobbs (HDH) Vitality Index, 2014, 2017, 2019; Knight Frank, 2017). A further consideration in their selection is that these retailing centres have experienced differing degrees of urban regeneration. Two retailing centres - Glasgow and Nottingham - have had a relatively stable supply of retail floorspace over the study period while Liverpool increased by almost 63 % and is now the largest. Interestingly, the newer units in Liverpool tend to be bigger than the shops in Glasgow and Nottingham. Table 1 also illustrates that Edinburgh and Hull are the smallest of the centres. Both have experienced extensive retail development activity over the study period although the retail floorspace fell in Edinburgh in 2016 due to the closure of the St James Shopping Centre (PMA, 2021). Thus, with the sample purposefully constructed to reflect city heterogeneity and a breadth of experiences, the study should yield meaningful and applicable insights into use changes and urban renewal processes.

5.2. Defining the retailing centre within the case study cities

Guy (1998) defines a retailing area as an unplanned cluster of shops that tends to develop and grow through the gradual conversion of buildings and land from other uses. The areas tend to consist of many separate buildings with diverse ownership. This typically reflects the traditional “High Street” in our cities, towns and suburbs where property ownership may be fragmented and the physical appearance of units is typically not uniform or standardised. These (often) linear shopping ribbons differ from a shopping centre/mall which is a planned group of retail outlets, usually in a single purpose-built or converted building with an identifiable physical appearance (Brown, 1991). More recently, Ordnance Survey, the UK's national mapping service, took a similar approach to Brown, defining a High Street to be any cluster of 15 or more buildings, less than 150 m apart, containing retail or food and drink units along a single road (Ordnance Survey, 2019).

This study looks beyond single streets to the clustered streets and buildings within core retailing areas. The primary shopping area (PSA) within an urban centre in England is defined in the National Planning Policy Framework (Ministry of Housing, Communities and Local

² Published retail index rankings vary significantly, making accurate time series analysis of the centres a little difficult. In the multiple score count index issued by Hillier Parker (1996) Glasgow in 1995 was 2, Edinburgh 5, Nottingham 6; Hull 10 and Liverpool was lowest ranked at 17. In the more recent HBH vitality indices, Edinburgh and Glasgow remained highest ranked but the order had switched - Edinburgh moved 17 to 15 while Glasgow moved 56 to 33 between 2014 and 2019. All three English centres fell - Hull 170 to 625 in 2017 and even higher in 2019; Liverpool 33 to 48 and Nottingham fell 52 to 54 with Liverpool over the period between 1995 and 2014 climbing above both Nottingham and Hull.

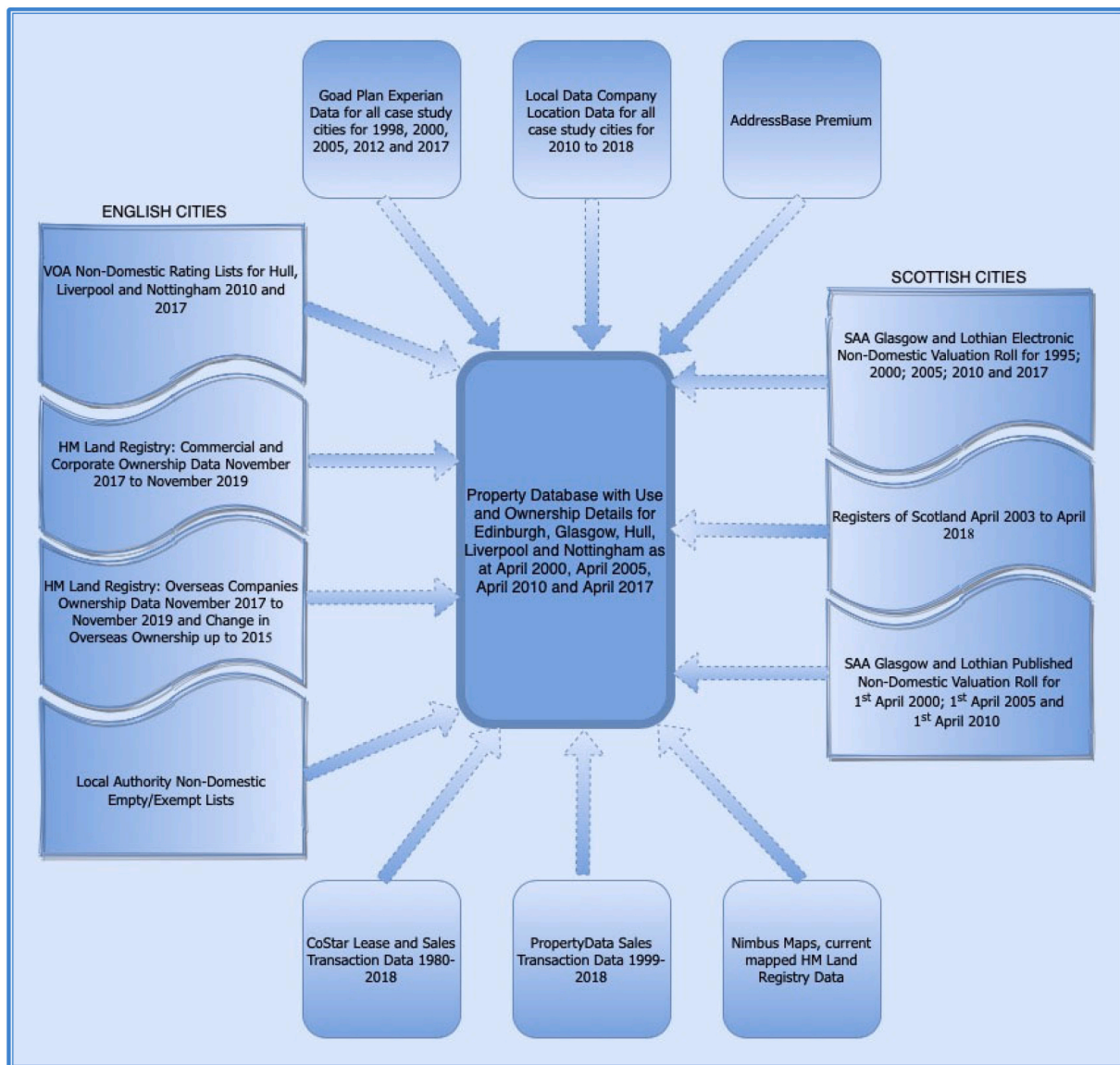


Fig. 1. Data linkages and creation of non-domestic property databases.

Government, 2019, pg. 70) as the “defined area where retail development is concentrated” although some planning authorities, refer to the city centre PSA as the main retail area. In Scotland, the retail core in a city or town centre is referred to as the principal retail area (PRA) and is identified by the controlling local authority as the preferred location for retail development (Scottish Government, 2014). These policy-defined in-town shopping areas encapsulate both traditional unplanned retail clusters and planned shopping malls within the central retail and commercial districts, and are used to define the retailing centres under study. They represent far wider areas than previously studied and more fully reflect the centralised agglomeration of retailing and services formed by the economic and market forces within cities.³ The boundaries of the PSAs and PRAs in the case studies have all changed during the study period as the centres have evolved. To ensure change was fully explored,

³ For practical reasons the study was contained to PRA/PSA to make the data processing manageable within the project’s timeframe. It also enabled the influence of specialist functions, found in select cities, to be excluded from the analysis as they tend to locate outside the retailing and commercial area. For example, Edinburgh as an administrative capital tends to have national government uses not found in other cities but these are located outside its PRA.

the widest boundaries and, furthermore, a buffer zone, was selected for the study.⁴

5.3. Case study area data and data linkage

Occupier and use data are collated for all the properties within the study areas. This involves linking a series of administrative and commercial datasets to provide an original spatial stock database for each city (see Fig. 1).

The Non-Domestic Rating Valuation List (Valuation Roll in Scotland) contains a snapshot of all retail and commercial property units in each urban centre eligible for local taxation purposes with their use, the net annual value, and changes in re-estimated net annual value. These records, which were initially delineated by the corresponding city centre

⁴ There were two exceptions to this. The extension to Edinburgh’s PRA across North Bridge, which was present in the 2010 City Plan but removed in 2016, and the London Road strategic area in Liverpool were excluded from the case study areas as the Project Steering Group felt they were disconnected from the main retail cores.

postcode sectors⁵ to make them easier to work with, are linked for each property to create a database of the stock with official use and rateable value at each observation point. For the Scottish properties this involved linking the valuation roll records for Glasgow city centre (from the City of Glasgow roll) and Edinburgh city centre (from the Lothian Roll) for 1st April 1995, 1st April 2000, 1st April 2005, 1st April 2010 and 1st April 2017. These are linked by address, allowing for subdivisions and mergers, as identified in the record codes, and linked to size data and the details of occupiers and proprietors copied from the online Scottish Assessors Association (SAA) database, as at December 2018.

For the English properties the collation process involved linking the list entries for 1st April 2010 and 1st April 2017 from the Valuation Office Agency (VOA) Non-Domestic Rating Lists by Unique Assessors Reference Number (UARN) and then linking unlinked records by address because the VOA tends to change a property's UARN when the property or the occupying taxpayer changes. These records are also linked to the history and summary records by UARN to get size data, changes in rateable value, and the reason for the change. This allows rateable value changes due to appeals (and checks and challenges in England since 2017) to be differentiated from changes due to change in use. The property entries for 2000 and 2005 cannot be linked into the stock database as the legal obligation for the VOA to make information about the Non-Domestic Rating Lists for 2005 (and earlier) available came to an end on 31st March 2017, which means they no longer publish these lists or make them available outside the VOA.

The valuation stock data was also linked by UARN to empty property lists provided by Hull City Council, Liverpool City Council and Nottingham City Council via their data portals or Freedom of Information requests, as these lists contain information on vacant properties, taxpayers and account start dates. These VOA data lists identify vacant commercial units as those where the owner claims empty property relief, although this does not identify units where the owner continues to pay rates and the units are under-utilised (Findlay & Sparks, 2010, 2012).

The city-level non-domestic stock databases created were then linked by address to: annual Goad Plan survey data for 1998, 2000, 2005 and 2007, and biannual survey data for 2012 and 2017; Local Data Company datasets for 2010; 2011; 2017 and 2018; sales and long leasehold records from the Land Registers or the HM Land Registry Company and Overseas transaction datasets depending on city; and, property lease and sale transaction data held in CoStar and PropertyData.com. The records were then cleaned to create variables with the name and details of occupiers and owners on the 1st April in 2000, 2005, 2010 and 2017. As part of this process, the occupier and owner variables in the stock databases created for Glasgow and Edinburgh were then cross-referenced against the occupier and proprietor data recorded in the valuation rolls held on public display and Google Streetview, which typically extends back to 2008. Google Streetview is also used to confirm occupiers in the English cities, and Nimbus Maps enables properties currently held by private individuals in these cities to be identified, filling gaps in the HM Land Registry under the Open Government License. Where an information gap occurs in the history of a property or data cannot be confirmed, 'unknown' is recorded. The proportion of unknowns varies between 0% and 0.3% in 2010 and 2017 but increases in 2000 and 2005 with the highest being 36.6% of stock entries in Liverpool in 2000.

As a final stage in the creation of the city-level stock databases, the records were linked to the eastings and northing co-ordinates in the AddressBase Premium dataset as this provides a consistent mapping methodology. For the English properties the linking is automated by Unique Property Reference Number (UPRN) as this variable is provided

⁵ Edinburgh – EH1 1, EH1 2, EH1 3, EH2 1, EH2 2, EH2 3, EH2 4, EH3 6, EH3 7 and EH3 8. Glasgow – G1 1, G1 2, G1 3, G1 4, G1 5, G2 1, G2 2, G2 3, G2 4, G2 5, G2 6 and G2 8. Hull – HU1 1, HU1 2, HU1 3 and HU2 8. Liverpool – L1 1, L1 2, L1 3, L1 4, L1 8, L2 1, L2 6, L2 9 and L3 5. Nottingham – NG1 1, NG1 2, NG1 3, NG1 4, NG1 5, NG1 6 and NG1 7.

in the valuation lists. In Scotland, the address is used to manually match the properties to the entries in AddressBase Premium. These were then mapped and their location cross checked against their address. AddressBase Premium also contains details of domestic properties in the study area although some inconsistencies are found in the way purpose-built student accommodation is classified (sometimes being wrongly classified as standard residential dwellings) and list dates often do not tie in with the dates these properties entered the housing market. The list of identifiable domestic properties was cross-checked against the effective dates in the council tax lists to provide a separate database of residential units in the study areas. This provides a holistic view of property use within the study areas.

5.4. Classifying property use

A classification is needed to ensure all changes in property uses in the constructed stock databases can be analysed meaningfully over time. Both Experian and the Local Data Company employ classifications based on a combination of type of goods sold, shopping trip purpose, ownership and use class but the definitions they use differ. For example, the primary activity defined by Experian has at least 287 different categories while Local Data Company has 373. Given that data from these two sources were combined, standardisation was needed. The priority for this process is to ensure a manageable yet meaningful classification is applied consistently between time periods and across locations (Guy, 1998). This reclassification enables anomalies within data sets to be identified and addressed, such as an Italian restaurant variously defined as an Italian restaurant, or simply a restaurant, without the fascia or occupier changing.

The revised classification⁶ dissects non-domestic property use into 11 broad categories: Shops; Entertainment, Leisure and Recreation; Food and Drink; Accommodation Services; Public and Social Value Services; Business, Commerce and Office Space; Industrial; Transport-Related; Vacant; and Other and Unknown uses. Shops were further subdivided into: comparison; convenience; and unknown shops. Comparison retailers, as well as the Entertainment, Leisure and Recreation, Food and Drink and Accommodation Services categories, are dissected further by the type of goods or service they provide (see Table 2 for the property uses that fall under each broad category), while convenience retailers were segmented by store format or specialist products sold. Public and Social Value Services were subdivided by property type, such as library, health centre, place of worship, which reflects the type of services they provide to the community. The total number of sub-categories is 68, which achieves the aim of capturing meaningful variation (but not hiding significant patterns through too many categories), while retaining manageability for analysis.

Using ArcGIS, a 100 m by 100 m fishnet grid was created for each of the five retailing areas, with every individual property unit assigned to a square cell within the grid.⁷ 'Richness' (R) was calculated for each grid cell using count analyses, focusing on the presence of different categories of known use operators (ignoring vacant units and 'unknown'). This then fed into the development of diversity indices, as defined in Eqs. (2) and (3), both for each cell and for each overall study area.

6. Analysis of use diversity and interpretation

The analysis begins with an overview of the property stock contained in the created databases before investigating the variation in property use and use diversity as part of the adaptive cycle of urban retailing

⁶ The full classification is listed in Table SF1 in the Supplementary Material.

⁷ This created small area metrics, approximately the size of a street block, that enable direct spatial comparison. Alternatively, individual properties could have been assigned to the nearest street to create street based indices but the measures would have been influenced by the variable length of streets.

Table 2

Property uses classified within each broad use categories.

Broad use category	Type of products and services in category
COMPARISON SHOPS	Department stores; variety stores; toys and games; music, film and books; jewellery; fashion and clothing; household goods; electrical goods; phones; arts and craft; confectionary; haberdashery and textile; pop ups, stalls and market barrows; sports goods; health and beauty; travel agents; cards; gifts; souvenirs; stationary; banks and building societies; estate agents; post office; charity shops.
BUSINESS, COMMERCE & OFFICE	Offices; serviced offices; co-working space; storage.
VACANCIES	Vacant; under construction or refurbishment; obsolete and about to be demolished.
FOOD AND DRINK	Restaurants; fast food; bars; public houses; cafes and coffee shops.
CONVENIENCE SHOPS	Grocery stores; delicatessen; corner shops; newsagents; supermarkets; tobacconists and E-cigarette/vaping; off-licenses.
ACCOMMODATION SERVICES	Hotels; serviced accommodation; guest houses/B&Bs; hostels; student halls of residence.
ENTERTAINMENT, LEISURE & RECREATION	Cinema; theatres; concert halls, comedy clubs; entertainment centres; nightclubs and discos; sports facilities; museum; art galleries; tourist attractions; bingo halls, casinos; snooker halls.
TRANSPORT	Car parks; transport and ticket offices; rail and bus stations.
PUBLIC & SOCIAL VALUE SERVICES	Doctors; dentists; blood donation centres; chiropractors; housing associations, women's health centres, support centres; libraries; Job Centres; career offices; Citizen's Advice Bureaus; community centres; municipal buildings; places of worship.
INDUSTRIAL	Workshops; industrial units.
OTHER	Anything that does not fall in the categories above.

centres. This provides the context for the key urban changes occurring in the retailing centres, before providing a comparative analysis of spatial changes occurring between and within the case study areas.

6.1. Property stock, change in use and diversity and the adaptive cycle

To provide details of the properties examined in the analysis, [Table 3](#) shows the count analysis for aggregated broad use categories in each retailing centre over the study period. This enables assessment of the extent to which the centres have adapted to the changing social and economic environment. Edinburgh and Glasgow are set out at the top of [Table 3](#). The databases provide an almost complete picture of building usage, with the use known for 99.5 % or more legally recognised non-domestic properties (excluding individual private car parking spaces, telecoms, ATMs, and advertisement boards and stations). The results for the English cities are set out in the lower sections of [Table 3](#), and show a higher number of unknown property uses, largely due to the withdrawal of the 2000 and 2005 VOA business rating lists. A sizable proportion of the unknowns are likely to be upper floor offices and stores as this space is generally not covered by the Goad Plan surveys. Coverage of commercial data providers also varies across the cities, but generally improved over the course of the study period.

The property use data presented in [Table 3](#) reveal that on average comparison retailing was the dominant use in 2017, accounting for 31.06 % of properties. There are differences within the sample, however. Over the whole study period, comparison retailing was the dominant property use in the three English cities but the second most dominant in the two Scottish cities, behind offices. The number of offices and storage facilities is the second highest property use when averaged across the five centres although, as above, it is the highest in Glasgow and Edinburgh which have seen a greater rise in serviced office space while more offices in the other centres have either been left vacant or converted into alternative property uses. Breaking this down, the subdivision of office accommodation, previously single occupancy or vacant, into smaller, more flexible units is a trend evident in all five study areas. The establishment of the serviced office sector ([Dabson & McAllister, 2014](#)) has driven this change with smaller local property companies dominating the more established operators, such as Regus and WeWorks. In the three English cities the data suggest a surge in offices and storage developments between 2005 and 2010 but a proportion of the unknowns in 2000 and 2005 are likely to be offices or stores so an assumption cannot be made in this regard. The office and store figures between 2010

and 2017 are more reliable and highlight shrinkage in this element of stock. This is due to former offices being redeveloped into hotels and residential units.⁸

Three further areas of similarity are evident from the data in [Table 3](#). First, there was a rise in empty properties, representing the third largest property 'use', on average, in 2017 and, furthermore, the area of greatest growth over the study period overall, and for all cities from 2010 to 2017. Second, there was an increase in food and drink establishments, which partly offset the gap left on the High Street by the contraction in comparison retailing, particularly, fashion and clothing, household and gardening, and electrical goods and phone sectors (see [Table SF1](#) in the Supplementary Material). This is a sign that these retailing systems are adjusting in response to shifting consumer tastes, reflecting the growth in café culture and changes in consumer behaviour towards leisure services identified in the UK by [Wrigley and Dolega \(2011\)](#), and the re-organisation of retailing functions, although there is some variation in the pattern of change. This use category ranked as the fourth largest in 2017 when averaged across the five centres, with all centres experiencing growth. Third, there was an increase in convenience retailing (fifth largest property 'use') between 2010 and 2017 in all cities which accompanied the growth in accommodation services and residential units.

The growth in alternative property uses and contraction in comparison shopping, revealed by [Table 3](#), implies greater variety in each retailing area since 2000, but it is difficult to say from this count analysis if these centres have become more diverse. Richness (R), Gini-Simpson index (1-D), Shannon's diversity index (H) and Shannon's equitability index (E_H), measure the diversity of property use, estimated using disaggregated count data for commercial and domestic uses⁹ (see [Table 4](#) for city level). The Richness indicator, estimated from the disaggregated data, shows a more mixed picture. Across the four observation dates, Richness showed only small changes and these movements were variously up and down, as new property uses emerged (for instance, betting shops, short term lets, and vaping shops) and established uses left the city centres (for example, libraries, job centres, bank and building societies, haberdasheries and textile shops). However, digging into the underlying data in each centre reveals some patterns of note.

First, nearly all the centres saw use richness rise in the wake of development activity. For example, richness rose between 2005 and

⁸ This trend has been driven by the permitted development rights introduced in England in 2014 that allowed office-to-residential conversions.

⁹ The count of residential units includes the count of flats, houses, bedsits and rooms with separate postal addresses as detailed by AddressBase Premium and the Council Tax list. Individual flats within student halls of residence (AS5) are counted separately but classed as AS5 rather than as residential.

Table 3
Number and variety of non-domestic properties and estimated residential units.^a

	2000		2005		2010		2017		2000		2005		2010		2017	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
EDINBURGH								GLASGOW								
COMPARISON SHOPS	358	33.2 %	376	30.8 %	347	26.7 %	304	20.7 %	794	25.0 %	777	27.8 %	749	27.0 %	761	22.8 %
BUSINESS, COMMERCE & OFFICE	437	40.5 %	489	40.0 %	506	39.0 %	602	41.0 %	1487	46.8 %	1008	36.1 %	1100	39.7 %	1378	41.3 %
VACANCIES	84	7.8 %	156	12.8 %	236	18.2 %	302	20.5 %	286	9.0 %	497	17.8 %	396	14.3 %	678	20.3 %
FOOD AND DRINK	103	9.6 %	115	9.4 %	117	9.0 %	140	9.5 %	204	6.4 %	200	7.2 %	215	7.8 %	276	8.3 %
CONVENIENCE SHOPS	18	1.7 %	15	1.2 %	15	1.2 %	22	1.5 %	33	1.0 %	37	1.3 %	37	1.3 %	43	1.3 %
ACCOMMODATION SERVICES	17	1.6 %	21	1.7 %	28	2.2 %	62	4.2 %	8	0.3 %	11	0.4 %	13	0.5 %	43	1.3 %
ENTERTAINMENT, LEISURE & RECREATION	14	1.3 %	16	1.3 %	17	1.3 %	16	1.1 %	42	1.3 %	42	1.5 %	39	1.4 %	42	1.3 %
TRANSPORT	2	0.2 %	2	0.2 %	4	0.3 %	2	0.1 %	23	0.7 %	26	0.9 %	28	1.0 %	30	0.9 %
PUBLIC & SOCIAL VALUE SERVICES	7	0.6 %	4	0.3 %	9	0.7 %	6	0.4 %	16	0.5 %	14	0.5 %	17	0.6 %	19	0.6 %
INDUSTRIAL	3	0.3 %	2	0.2 %	2	0.2 %	3	0.2 %	80	2.5 %	36	1.3 %	49	1.8 %	20	0.6 %
UNKNOWN SHOPS	25	2.3 %	18	1.5 %	14	1.1 %	6	0.4 %	161	5.1 %	131	4.7 %	111	4.0 %	43	1.3 %
OTHER	10	0.9 %	8	0.7 %	4	0.3 %	5	0.3 %	42	1.3 %	14	0.5 %	15	0.5 %	7	0.2 %
KNOWN USE	1078	99.9 %	1222	99.9 %	1299	99.8 %	1470	99.9 %	3176	99.5 %	2793	99.7 %	2769	99.8 %	3340	100.0 %
UNKNOWN USE	1	0.1 %	1	0.1 %	3	0.2 %	1	0.1 %	15	0.5 %	9	0.3 %	6	0.2 %	0	0.0 %
TOTAL NON-DOMESTIC	1079		1223		1302		1471		3191		2802		2775		3340	
EST. TOTAL RESIDENTIAL	317		452		478		482		327		719		1064		1088	
HULL								LIVERPOOL								
COMPARISON SHOPS	391	55.7 %	376	53.1 %	408	43.5 %	364	38.0 %	563	68.2 %	570	51.0 %	703	45.8 %	540	39.7 %
BUSINESS, COMMERCE & OFFICE	114	16.2 %	103	14.5 %	208	22.2 %	166	17.3 %	70	8.5 %	90	8.1 %	369	24.1 %	205	15.1 %
VACANCIES	27	3.8 %	111	15.7 %	167	17.8 %	258	26.9 %	38	4.6 %	283	25.3 %	153	10.0 %	306	22.5 %
FOOD AND DRINK	56	8.0 %	65	9.2 %	79	8.4 %	96	10.0 %	95	11.5 %	103	9.2 %	162	10.6 %	202	14.9 %
CONVENIENCE SHOPS	21	3.0 %	19	2.7 %	16	1.7 %	28	2.9 %	18	2.2 %	22	2.0 %	25	1.6 %	27	2.0 %
ACCOMMODATION SERVICES	1	0.1 %	1	0.1 %	2	0.2 %	2	0.2 %	2	0.2 %	2	0.2 %	12	0.8 %	16	1.2 %
ENTERTAINMENT, LEISURE & RECREATION	8	1.1 %	6	0.8 %	15	1.6 %	20	2.1 %	13	1.6 %	14	1.3 %	20	1.3 %	23	1.7 %
TRANSPORT	67	9.5 %	4	0.6 %	9	1.0 %	10	1.0 %	3	0.4 %	3	0.3 %	8	0.5 %	9	0.7 %
PUBLIC & SOCIAL VALUE SERVICES	8	1.1 %	9	1.3 %	12	1.3 %	9	0.9 %	8	1.0 %	12	1.1 %	9	0.6 %	7	0.5 %
INDUSTRIAL	0	0.0 %	0	0.0 %	1	0.1 %	1	0.1 %	1	0.1 %	4	0.4 %	8	0.5 %	6	0.4 %
UNKNOWN SHOPS	9	1.3 %	14	2.0 %	14	1.5 %	1	0.1 %	13	1.6 %	14	1.3 %	63	4.1 %	15	1.1 %
OTHER	0	0.0 %	0	0.0 %	7	0.7 %	3	0.3 %	1	0.1 %	0	0.0 %	2	0.1 %	3	0.2 %
KNOWN USE	702	75.6 %	708	76.3 %	938	99.8 %	958	100.0 %	825	63.4 %	1117	72.1 %	1534	99.8 %	1359	99.9 %
UNKNOWN USE	226	24.4 %	220	23.7 %	2	0.2 %	0	0.0 %	477	36.6 %	433	27.9 %	3	0.2 %	2	0.1 %
TOTAL NON-DOMESTIC	928		928		940		958		1302		1550		1537		1361	
EST. TOTAL RESIDENTIAL	73		110		175		357		77		215		903		1430	
NOTTINGHAM																
COMPARISON SHOPS	673	51.3 %			699	45.4 %			658	31.6 %			650	34.1 %		
BUSINESS, COMMERCE & OFFICE	201	15.3 %			369	24.0 %			750	36.1 %			526	27.6 %		
VACANCIES	106	8.1 %			111	7.2 %			219	10.5 %			294	15.4 %		
FOOD AND DRINK	165	12.6 %			191	12.4 %			211	10.1 %			256	13.4 %		
CONVENIENCE SHOPS	30	2.3 %			32	2.1 %			36	1.7 %			42	2.2 %		
ACCOMMODATION SERVICES	6	0.5 %			8	0.5 %			17	0.8 %			23	1.2 %		
ENTERTAINMENT, LEISURE & RECREATION	19	1.4 %			25	1.6 %			30	1.4 %			29	1.5 %		
TRANSPORT	25	1.9 %			25	1.6 %			27	1.3 %			25	1.3 %		
PUBLIC & SOCIAL VALUE SERVICES	11	0.8 %			12	0.8 %			21	1.0 %			18	0.9 %		
INDUSTRIAL	19	1.4 %			28	1.8 %			48	2.3 %			34	1.8 %		
UNKNOWN SHOPS	50	3.8 %			32	2.1 %			45	2.2 %			2	0.1 %		
OTHER	7	0.5 %			7	0.5 %			18	0.9 %			9	0.5 %		
KNOWN USE	1312	63.8 %			1539	73.4 %			2080	99.7 %			1908	100.0 %		
UNKNOWN USE	745	36.2 %			558	26.6 %			6	0.3 %			0	0.0 %		
TOTAL NON-DOMESTIC	2057				2097				2086				1908			
EST. TOTAL RESIDENTIAL	765				1102				1299				1968			

^a The estimated number of residential units were calculated from the residencies listed in AddressBase Premium and the Council Tax list. It is only an estimate as it may omit the residential units that been demolished or removed from the Council Tax list.

Table 4
Changing use diversity.

	EXCLUDING HOUSING				INCLUDING HOUSING			
	Richness (R)	Gini-Simpson Index (1-D)	Shannon Index (H)	Shannon Equitability (E _H)	Richness (R)	Gini-Simpson Index (1-D)	Shannon Index (H)	Shannon Equitability (E _H)
	EDINBURGH							
2000	48	0.777	2.468	0.638	49	0.813	2.418	0.621
2005	48	0.761	2.377	0.614	49	0.793	2.272	0.584
2010	46	0.748	2.327	0.608	47	0.783	2.220	0.577
2017	49	0.718	2.248	0.578	50	0.773	2.194	0.561
GLASGOW								
2000	50	0.689	2.161	0.552	51	0.741	2.270	0.577
2005	51	0.764	2.420	0.615	52	0.805	2.378	0.602
2010	50	0.747	2.365	0.604	51	0.781	2.235	0.568
2017	51	0.710	2.249	0.572	52	0.769	2.194	0.555
HULL								
2000	44	0.929	3.092	0.817	45	0.937	3.034	0.797
2005	44	0.927	3.086	0.816	45	0.943	2.743	0.721
2010	48	0.892	2.944	0.760	49	0.923	2.577	0.662
2017	52	0.912	3.073	0.778	53	0.896	2.305	0.581
LIVERPOOL								
2000	48	0.898	2.901	0.749	49	0.915	2.858	0.734
2005	46	0.901	2.922	0.763	47	0.935	2.409	0.626
2010	49	0.871	2.740	0.704	50	0.816	2.212	0.565
2017	51	0.921	3.082	0.784	52	0.723	1.863	0.471
NOTTINGHAM								
2000	52	0.931	3.166	0.801	53	0.835	2.494	0.628
2005	51	0.897	2.967	0.755	52	0.792	2.286	0.579
2010	54	0.811	2.626	0.658	55	0.792	2.129	0.531
2017	53	0.869	2.867	0.722	54	0.719	1.902	0.477

2010 in Liverpool and Hull, coinciding with the creation of Liverpool One and St Stephen's (Hull),¹⁰ although during the same period use diversity fell as the relative abundance of use became more uneven. In Glasgow there was a similar pattern between 2010 and 2017 following the extension of the St Enoch Centre and the conversion of a hotel into Buchanan Quarter (a mixed retail and residential development), and the development of Nottingham's Trinity Square in 2008 saw richness rise and diversity fall.

Second, diversity rose and fell at different times suggesting the adaptive cycle theorised by [Dolega and Celińska-Janowicz \(2015\)](#) is complex with centres at different stages of development. There was also variation in the length of each stage, driven by national economic changes and local strategic priorities¹¹ which potentially heightened/dampened development activity at different stages. Using key property market indicators in the absence of agreed resilience metrics ([Martin & Sunley, 2015](#)), [Fig. 2a](#) to e identify different stages of the adaptive cycle, and how property use richness and diversity change between difference phases in the market.

Between 2000 and 2005 both Edinburgh and Hull seem to be in a consolidation phase, with richness remaining unchanged. Rental growth slowed in these smaller centres as they struggled to compete with the increase in suburban and out-of-town retail park developments that were better able to provide the large, regular floorplates sought by retailers and car parking for car-dependent shoppers. However, where richness, diversity, rents and shop market values subsequently fell and vacancy rates rose between 2005 and 2010 in Edinburgh (largely in

response to the impact of the global financial crisis (GFC) on consumer confidence and spending¹²), a rise in richness and vacancies, and a sharp fall in rents and market values coincided with the creation of St Stephen's in Hull. Between 2010 and 2017 both centres appeared to be going through a period of reorientation with richness rising at a time when retail rents and vacancy rates showed signs of instability as national retailers (such as Clinton Cards, BHS, and JJB Sports ([Centre for Retail Research, 2021](#))), unable to compete against the 60 % growth in non-food online retailing ([Office for National Statistics, 2021](#)), entered into administration. The greater evenness in uses saw diversity increase in Hull as the representation of independent retailers and operators increased ([Orr et al., 2021](#)), but decrease in Edinburgh, where the relative abundance of uses became more uneven, primarily due to the closure of the St James Centre for redevelopment. A key difference between these two centres is that the average town centre vacancy rate over the study period in Edinburgh has been lower (7.3 %) and more stable than Hull (12.7 %), possibly reflecting the greater affluence of Edinburgh, an administrative and financial centre, relative to the port city of Hull. The weaker socio-economic profile of Hull relative to its neighbouring centres has led to the city being hit hardest by the closure of multiple branch retailers, and taken longer to reorientate as it has struggled to attract new national retailers and operators who use catchment data analytics to make store location decisions ([Orr et al., 2021](#)).

Glasgow appears to have gone from a period of growth to consolidation during 2000 to 2005. This followed the endogenous supply shock created by the opening of Buchanan Galleries in 1999, when the number of different uses (richness), diversity and rent rose. Rents continued to rise for the next three years, followed by a slowing of growth and a dip in diversity and richness in the wake of the GFC. This was quickly followed by reorientation and the start of a new phase of growth between 2010 and 2017 when richness, and rents rose again. Yet, during the latter two

¹⁰ Liverpool One is a large open-air shopping mall, leisure and residential complex developed in Liverpool between 2004 and 2009. St Stephen's is a traditional shopping mall that opened in Hull in 2007.

¹¹ The development of St Stephen's Shopping Centre and Liverpool One occurred as public-sector led urban renewal projects which attempted to reverse the decline in the retail ranking of these centres. In Edinburgh, the demolition of the St James Centre in 2017, as part of a private-sector led mixed-use redevelopment project, took ten years to get planning permission due to it being in a World Heritage Area ([Orr et al., 2021](#)).

¹² Retail expenditure fell by 0.3 % between 2007 and 2008 with some comparison retailing sectors, for example textiles, household goods and cosmetics, hit harder than others ([Office for National Statistics, 2021](#)).

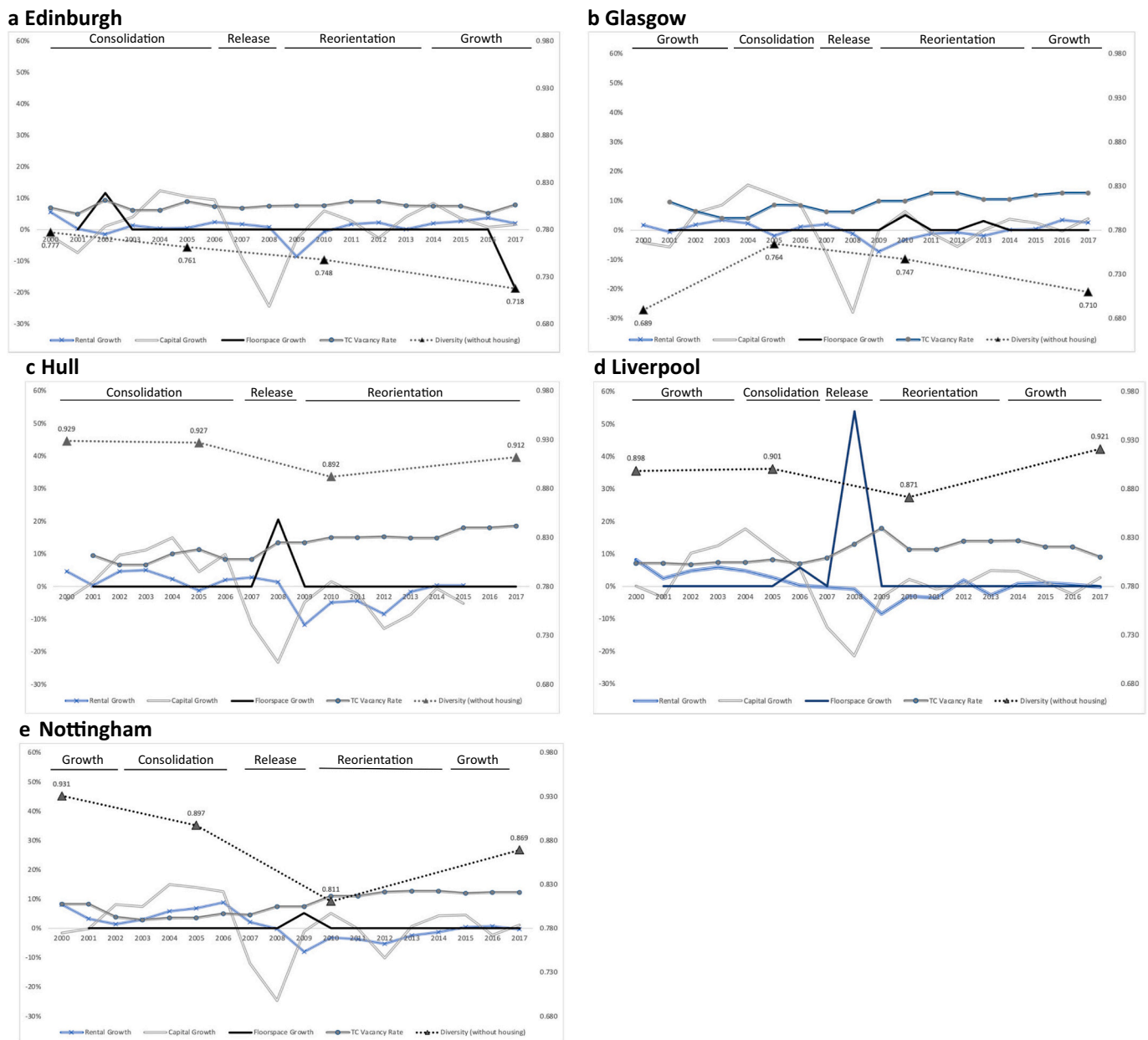


Fig. 2. Retail property market adaptive cycle in case study cities. Source: Town centre shop vacancy rates and retail floorspace growth adapted from PMA (2021) and market rental value growth and standard shop capital value growth from MSCI (2021).

phrases, the collapse of redundant retailers who failed to adjust effectively to omni-channel retailing and the emergence of new uses gave rise to uneven relative abundance, as well as a growth in shop vacancies outside the prime pitch which caused diversity across the centre to fall.

The number of different property uses (richness) dropped in Liverpool between 2000 and 2005, while an increase in the evenness of the concentration of uses saw diversity rise during this growth phase. This was followed by consolidation and release when the impact of the GFC coincided with the opening of Liverpool One. The surge in vacancies saw property capital values plunge, while diversity initially dipped but then grew – as long as the influence of residential development activity is ignored to enable focus on the change in non-domestic property use mix. Nottingham appears, at least in part, to have also been in a period of consolidation 2000 to 2005 but the fast release and reorientation stages following the GFC coincided with greater richness and falling diversity, if the change in housing is again ignored. Like many UK urban centres,

continued competition from out-of-town shopping malls and retail parks (Jones & Livingstone, 2018), the fall in consumer confidence in the wake of the GFC (OECD, 2022), and the increasing establishment of online retailing (Office for National Statistics, 2021) saw a contraction in comparison retailing as Nottingham entered a reorientation phase between 2010 and 2017. The resultant re-organisation of retailing and the food and drink sector during this phase in response to consumer behaviour becoming increasingly experiential in focus (White et al., 2022), created an uneven balance of new uses. Nottingham's retailing area then seems to have entered a period of slow growth where richness slightly fell, market rents rose and use diversity increased due to an increase in the concentration of property use.

6.2. Spatial comparison of property diversity and change of use

Disaggregating the level of analysis improves the sensitivity of the

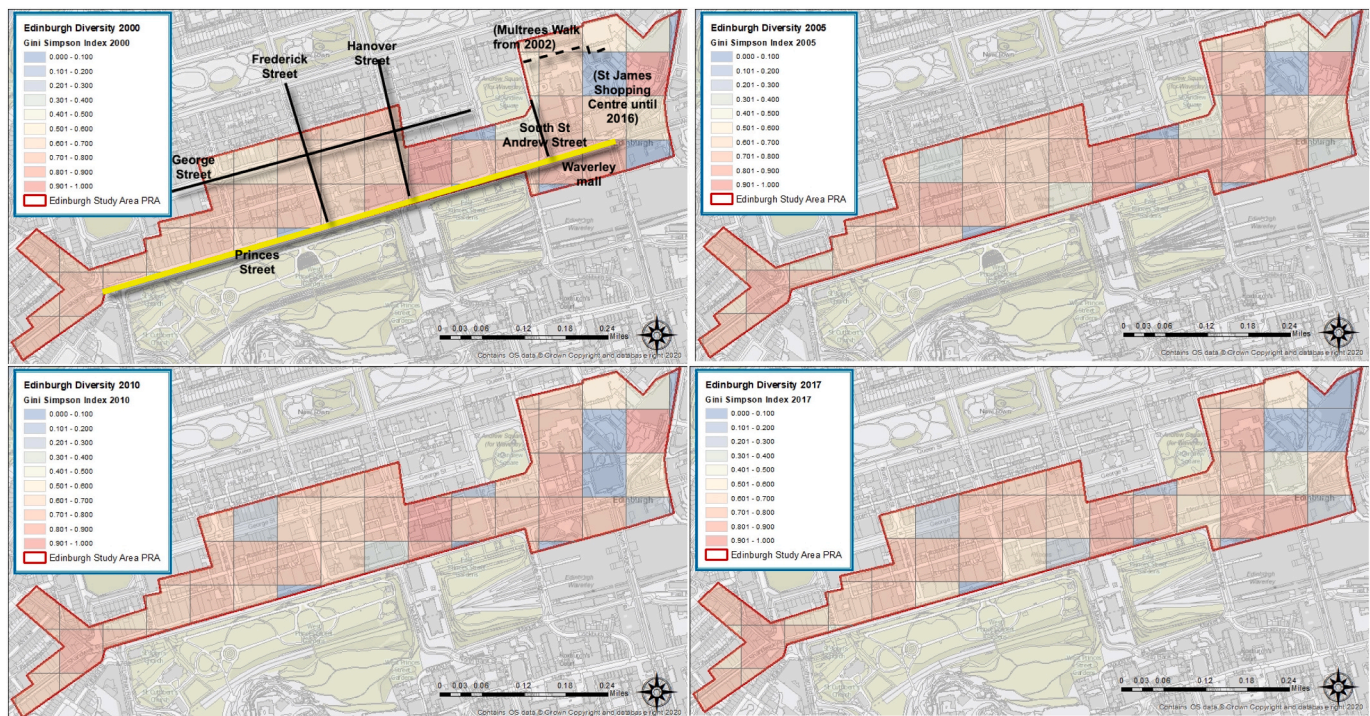


Fig. 3. Use diversity in Edinburgh's primary retail area 2000, 2005, 2010 and 2017.

metrics, and a comparison of property use changes and diversity over the study period reveals both similarities and differences as the five retailing centres have evolved. Figs. 3 to 7 plot the Gini-Simpson diversity index for all five centres in 2000, 2005, 2010 and 2017 and highlight the micro-level changes in diversity. The spatial variation in diversity evident in the figures demonstrates that aggregated metrics commonly used to measure the health of a retailing centre do not capture the changes that are happening at street level. Furthermore, it demonstrates that indices that focus on single streets do not capture wider yet fundamental characteristics and changes taking place in a location.

Exploring the findings shown in Figs. 3-7, the colour scale reveals that diversity generally followed a similar pattern as illustrated in Table 4, rising between 2000 and 2005, and then falling in 2010 and 2017. The significant Pearson correlation coefficients in Table 5 show moderate association between Gini-Simpson diversity and average shop net rateable values per square metre (market rent estimates used to determine business rates¹³) in 2000 and 2005 in Glasgow, Edinburgh, Hull and Nottingham but only 2000 in Liverpool. The positive relationships support the conclusion that diversity in these years tended to be highest in the streets that commanded the highest rents and contained the best investment assets (referred to as the prime pitch). However, the relationship weakens in 2010 and 2017, as evidenced by the low and insignificant correlation coefficients in Table 5, although clusters of high diversity (diversity above 0.800 being shown in deep orange and red in Figs. 3-7) had formed by 2017 where use richness (R) and evenness in relative abundance (E_H), estimated but not shown in the results, were high. These diversity hotspots typically relate to shopping malls and sections of the traditional prime retail pitch which appear to attract more complimentary comparison retail and leisure uses.

Table 3 reveals a growth in adaptation to alternative property uses

¹³ Business rating is a local property tax system that applies to non-domestic property in the UK. The rates are set at the effective dates – 1st April 2000, 1st April 2005, 1st April 2010 and 1st April 2017 – based on the market rent estimated by the VOA/SAA at an earlier time date.

but variation exists in the evenness of new uses within central areas. Key changes that have led to the increase in diversity in pockets of the five centres, has been the steady rise in the number of hotels (with the exception of Hull) and residential properties above ground floor. The resurgence of city living, a trend driven by young, affluent professionals and students who want to be close to restaurants, leisure and cultural facilities, to public transport, and to their workplace (Thomas et al., 2015) and local authority strategic planning priorities (Orr et al., 2021), also explains the growth in food and off-license stores. Convenience retailing (i.e. grocery stores, delicatessen, supermarkets, off-license stores, and newsagents), the fifth highest property use in Table 3 when averaged across all centres in 2017, has grown steadily in Liverpool, Glasgow and Nottingham whereas in Edinburgh and Hull it declined and then grew. Post-2010 growth has mainly been driven by the reversal in the supermarket decentralisation trend as food retailers adapted store formats in response to the “little and more often” change in grocery shopping behaviour (Wood & McCarthy, 2014). On the other hand, Public and Social Value Services sector, ranking ninth when averaged across all five centres, fell in Liverpool and three of the other retailing centres between 2010 and 2017, possibly related to the well-documented austerity cut-backs in public sector services in cities (for example, Hastings et al., 2017).

See the appendix for a fuller discussion of the micro-level variation in property diversity and change of use, shown in Figs. 3-7.

7. Discussion and conclusions

This paper has sought to investigate changes in property use and the relationship between diversity and adaptive capacity in five UK city centres. Drawing on complex systems theory as a conceptual framework, and developing detailed databases of each city, has allowed the evolution in property use and use diversity within the adaptive cycle of urban retailing centres to be explored over a period of almost two decades.

At the start of the study period, the larger city centres continued to grow and enter a consolidation phase. For the smaller centres, struggling more to compete with suburban and out-of-town retail parks and shopping centres, this happened earlier. The release phase that followed,

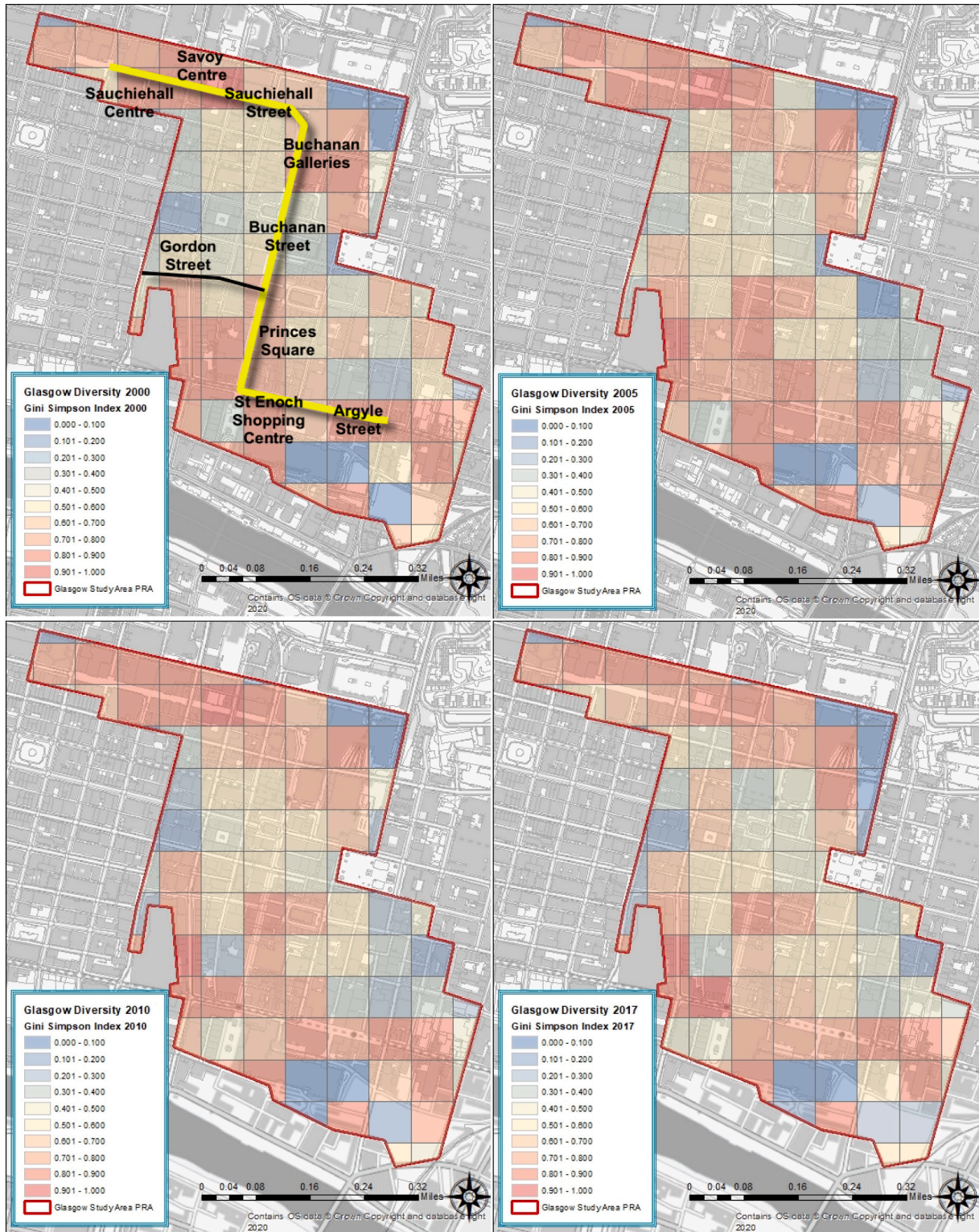


Fig. 4. Use diversity in Glasgow's primary retail area 2000, 2005, 2010 and 2017.

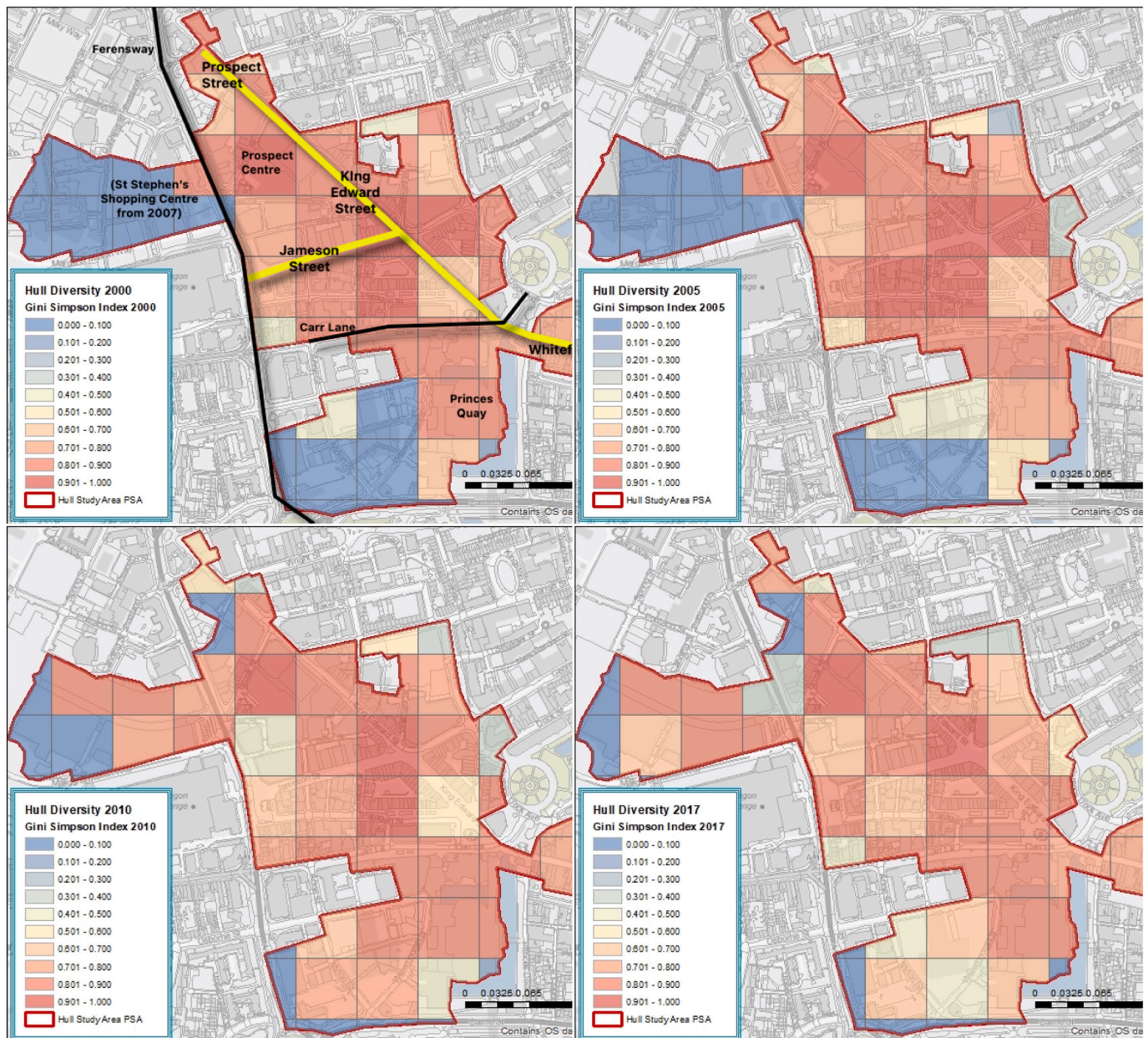


Fig. 5. Use diversity in Hull's primary shopping area 2000, 2005, 2010 and 2017.

coincided with supply shocks and the beginning of dramatic changes in consumer behaviour, retailing technology and the cost-effectiveness of physical retailing. While the centres have responded similarly in how they have repurposed redundant space and sought to expand their resident and visitor base, the speed of reorientation in Hull has been slower. This may partly be due to the relative size of the supply shock it experienced, and partly explained by its economic and social interdependences and structures. Similar in terms of affluence score and social structure to Glasgow and Liverpool (PMA, 2021), larger post-industrial cities, the port city of Hull has a higher unemployment rate, significantly smaller student base and its growth in tourism has been slower to materialise than the other centres. Edinburgh, while similar in terms of retail floorspace area to Hull, differs in that its catchment area residents are more affluent due to it being an administrative and financial centre, and is a major tourist destination.

The finding that complex variations in richness, diversity and relative abundance of use exist as centres evolve, suggests the timing and duration of development phases in the adaptive cycle are centre-specific

and shaped by local institutional structures, market dynamics and socio-economic interdependences. One pattern that seems to emerge is that centre-level richness and diversity tend to rise in a growth phase but fall during release. Another commonality that stands out is that the completion of large scale developments (e.g. Liverpool One), do not always occur during a growth phase, as theorised by *Dolega and Celínska-Janowicz (2015)*, due to lags in the development process and/or public-sector incentivisation.

The findings also reveal an increase in the variety of shops and services across all the principal shopping areas of the five cities. These areas are generally high in richness with the growth in hospitality and residential sectors suggesting a degree of adaptability in these markets, although these adjustments have not kept pace with the parallel surge in empty properties. The increase in vacancies outstripped all other changes suggesting that, while a degree of resilience is evident in these city centres, both the speed and scale of adaptation are failing to match the rapidly evolving retailing environment.

While comparison retailing remains the largest retail sector, it has

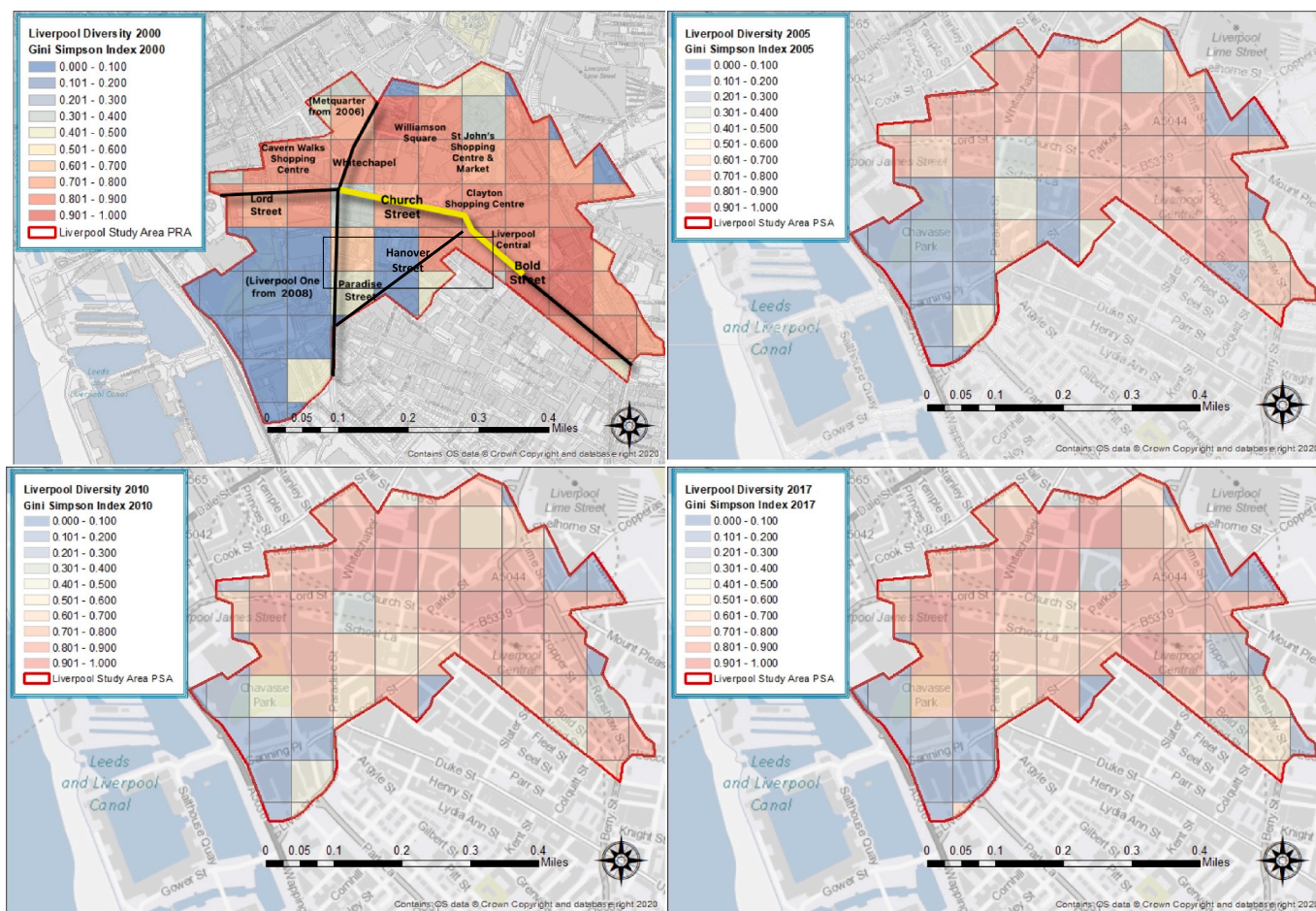


Fig. 6. Use diversity in Liverpool’s primary shopping area 2000, 2005, 2010 and 2017.

contracted. By contrast, micro-level data revealed that service-focused operations, often in the form of local independent beauty and health businesses, have expanded as lower competition from chain operators has resulted in some independents now being able to afford city centre locations. Food and drink outlets and the rise in financial and professional services have also partly off-set the contraction in comparison retail. This rise seems to have occurred earlier in Edinburgh than other centres, perhaps due to more flexible change of use planning policies in parts of the New Town to compensate for tighter controls in the Old Town, as well as its status and characteristics, as evidenced by its high rank for ‘affluence’ and ‘expenditure growth’ attributed by Knight Frank (2017). This highlights the purposively diverse nature of the sample, reflecting the wider heterogeneity in UK cities.

All centres lost large department and variety stores over the study period. While many former ground floor and basement shops appear to have been readily adapted into coffee shops, restaurants and public houses, it is these larger department store buildings that have tended to be slow to adapt. The sheer scale and depth of these units raise challenges for repurposing, an increasing issue across the UK at this time. It is notable that the establishment of more innovative entertainment, leisure and recreation uses seems to have lagged the expansion in food and drink, and possibly this section of the experiential economy offers opportunities to repurpose these large and awkward spaces.

A notable finding relates to the repurposing of vacant space in the first half of the study period, especially former storage and auxiliary space above ground floor retail, banks and office space into residential and student accommodation. While this has increased the resident population, there has been a contraction in public and social value services for those residents. This highlights the need for a policy rethink

on city centre futures as medical centres, dentists and nurseries are not only required, but may also offer a solution to the significant rise in vacancies in all the study areas. Further, it may be that these uses offer part of the solution to the repurposing challenges presented by the depth of the vacant large department store buildings, as they do not rely on passing trade and frontage, yet bring people into a location.

Such use changes, as described by Cachinho (2014), are essential to maintain the health and resilience of urban retailing centres. However, for this study, many of the new uses readily adopted are linked to hospitality, a sector that has been particularly hard hit by the pandemic and associated lockdown measures, making it impossible to assess the success of such use changes. These events only serve to reinforce the need for retailing centres to strive towards a more balanced mix of a wider range of uses, and to embrace the benefits online retailing offer. Innovation saw many retailers and operators survive the pandemic by using in-town physical stores to service online orders.

When investigated at a more disaggregated level, the diversity maps reveal that these developments lead to a spread in higher levels of diversity, usually at the expense of other locations within the centre. Greatest use density is typically to be found within shopping malls and on retailing prime pitches, although which parts of the prime pitch shifts over time possibly indicates changes in the preferred locations of shoppers and retailers, and planning policy changes regarding permitted property uses, accessibility and pedestrianisation.

These findings have relevance to planners and for town centre management policy. Many of the changes identified are necessary in the evolution of city centres but an increase in the speed of adjustment and a wider range of new uses are required if retailing centres are to adapt into better integrated and balanced commercial and leisure hubs, or

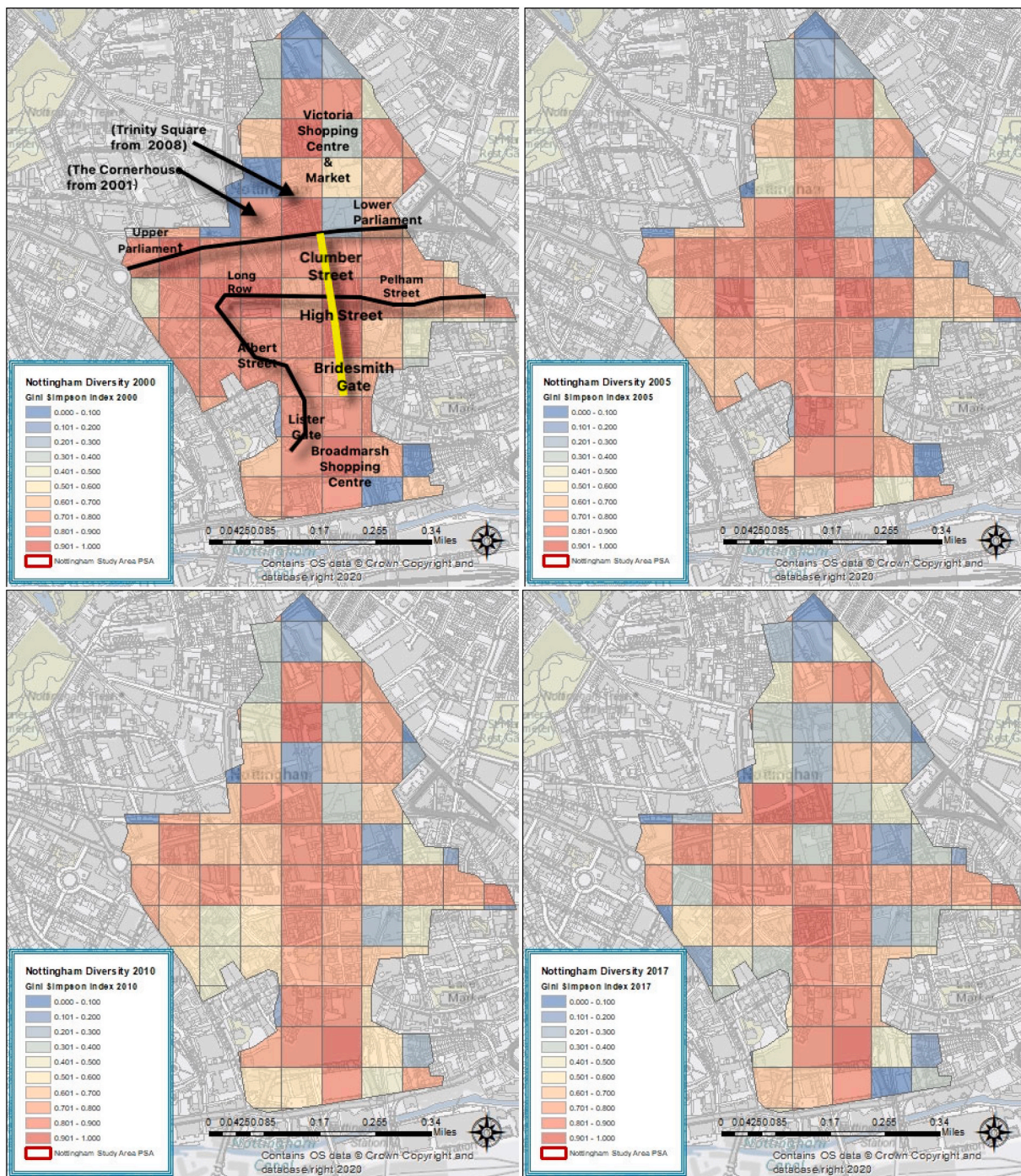


Fig. 7. Use diversity in Nottingham's primary shopping area 2000, 2005, 2010 and 2017.

transition in a more dramatic way into the mixed use neighbourhoods required to better support city living. The new Use Class Order ([The Town and Country Planning \(Use Classes\) \(Amendment\) \(England\) Regulation, 2020](#)) introduced in September 2020, with its territorial extent across England, will speed up change in use between retail, office, food and drink, leisure, creches and medical centres as they are now grouped together in the same use class, but will have little impact where building regulations and warrants are still required, or any significant effect on the adaptation of awkward or obsolete structures that require major building work. The unsatisfactory type and location of residential developments and poor quality of space identified by [Ferm et al. \(2021\)](#) as unintended outcomes of office-to-residential permitted development rights introduced in 2014 serve as a warning as no checks are in place to

monitor the latest stage in the deregulation of planning control in England. Moreover, other challenges remain that relate to the need for a fundamental repricing of retailing space in the face of wide scale vacancies, as this is often too expensive for independent occupiers and can hamper the financial viability of new use conversions.

The diversity metrics employed here allowed the multi-dimensional aspects of heterogeneity in property use to be measured: richness, evenness and concentration. They reveal a growth in adaptation to alternative property uses but show that the relative abundance of new uses is not even within central areas. It is also difficult to conclude if an optimum level of richness and diversity exists given that some property uses benefit from clustering and other inter-dependences. These findings, therefore, reveal inconsistencies and, thus, poise new questions.

Table 5

Pearson correlation coefficients measuring association between diversity and average shop rateable values (per square metre in terms of zone A). #,+

	2000	2005	2010	2017		2000	2005	2010	2017							
EDINBURGH					GLASGOW											
Richness (R)	0.292	***	0.183	0.051	0.064	Richness (R)	0.185	***	0.125	0.053	-0.003					
Gini-Simpson Diversity (1-D)	0.477	*	0.323	**	-0.070	0.192	Gini-Simpson Diversity (1-D)	0.464	*	0.467	*	0.437	*	0.377	*	
Shannon's Diversity Index (H)	0.509	*	0.374	*	0.050	0.189	Shannon's Diversity Index (H)	0.455	*	0.419	*	0.383	*	0.326	*	
Shannon's Equitability Index (E)	0.308	***	0.220		-0.073	0.261	***	Shannon's Equitability Index (E)	0.475	*	0.510	*	0.483	*	0.431	*
HULL					LIVERPOOL											
Richness (R)	0.481	*	0.466	*	0.072	0.142	Richness (R)	0.369	***	-0.241		0.257	**	-0.184		
Gini-Simpson Diversity (1-D)	0.432	*	0.535	*	0.242	***	0.257	***	Gini-Simpson Diversity (1-D)	0.431	*	-0.206		0.394	*	0.030
Shannon's Diversity Index (H)	0.498	*	0.576	*	0.237	***	0.287	**	Shannon's Diversity Index (H)	0.434	*	-0.159		0.433	*	-0.018
Shannon's Equitability Index (E)	0.199	*	0.278	***	0.217	0.195	Shannon's Equitability Index (E)	0.267	***	-0.239		0.374	*	0.112		
NOTTINGHAM																
Richness (R)	0.540	*	0.442	*	0.319	*	0.145									
Gini-Simpson Diversity (1-D)	0.236	**	0.295	*	0.236	*	0.112									
Shannon's Diversity Index (H)	0.384	*	0.392	*	0.306	*	0.143									
Shannon's Equitability Index (E)	0.009		0.155		0.133		0.081									

* 1 % Significance level; ** 5 % Significance level; *** 10 % Significance level.

+ Based on Cohen's (1988) conventions to interpret effect size, correlation coefficients between 0.10 and 0.29 (unshaded) represent a small association, coefficients between 0.30 and 0.49 (light shading) represent a medium association, and coefficients of 0.50 or higher (heavy shading) represent a strong association.

Further micro-level investigation is needed to uncover any barriers to change and, through this, enable greater balance in the process of change, or at least connectivity between use clusters, to strive towards city centres that are uniformly able to adapt to change. The spatial variation in diversity metrics also reveals that care is needed when using aggregated primary retail area level metrics as they can be misleading and not reflect what is happening at the street level.

The research provides innovation and enhanced understanding in two ways. Enabled through the development of five extensive and overarching databases, it reconsiders use diversity and use change as part of a retailing system, offering an alternative methodology to monitor and enhance vitality. Second, it contributes to the adaptive capacity theory by finding that the timing and duration of development phases are centre-specific, and perhaps more importantly spatially uneven. Increasing spatial variation in use seems to have occurred in some parts of the retailing centres while diversity has decreased in others, suggesting spatial externalities exist in market dynamics and that further investigation is needed to better understand the spatial interactions that are occurring, to avoid unforeseen problems as the repurposing of retail space gathers further momentum.

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CRedit authorship contribution statement

Allison Orr: Conceptualization, Data Curation, Investigation, Methodology, Visualization, Project Administration, Funding Acquisition, Writing - Original draft preparation. Joanna L. Stewart: Data Curation, Investigation, Visualization, Writing - Reviewing and Editing. Cath Jackson: Funding Acquisition; Writing - Reviewing and Editing. James White: Funding Acquisition; Writing - Reviewing and Editing.

Declaration of competing interest

None.

Data availability

The micro-data used in this study cannot be shared due to license restrictions. Data aggregated at various levels of aggregation is openly available from ReShare at 10.5255/UKDA-SN-855942

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Appendix A. Insights into the micro-level variation in property diversity and change of use shown in Figs. 3-7

In Edinburgh (Fig. 3) diversity followed the same general pattern, rising across most parts of the PRA between 2000 and 2005 as the retailing sector expanded in many UK cities, with a diversity hotspot forming on the east side of the core retail frontages on Princes Street (between Frederick Street and South St Andrew Street). Edinburgh has seen a steady decline in this sector over the study period (358 to 304 units; 33.1 % to 20.7 %) although part of the fall between 2010 and 2017 can be attributed to the redevelopment of the St James Shopping Centre as empty units were left unlet before closing completely in 2016. Retail units then accounted for only 9.3 % of the vacancies in 2017 with 72 shops being removed from the stock as part of this renewal project. Another notable change in Edinburgh was the rise in office and hotel space as local planning guidance during the study period, encouraged the conversion of vacant upper storage in the city centre.

In 2010, there was a shift in diversity away from the traditional prime retail premises on Princes Street, towards the streets behind (George Street and Rose Street) as rents lower than those on Princes Street helped these streets attract more affordable luxury retailers. (Orr et al., 2021). Diversity became concentrated in the remaining hotspots at the Waverley Centre and Multrees Walk, as well as the east end of George Street and in a section between Frederick and Hanover Street and on the western edge of Princes Street. At these points richness and evenness remained high while the decrease in richness in other locations due to the closure or relocation of many different types of comparison retailers has driven down diversity.

The closure of the St James Shopping Centre is captured by the low diversity spot that emerged in 2017. This has since been replaced by St James Quarter, a mixed use development with residential, office and retail space. Edinburgh has traditionally had a relatively high proportion of city centre residences, although this has tended not to be in the retailing area as upper floors are typically in commercial use. That said, the conversion of former office space to residential is a common, and

continuing, trend in all case study cities. Since the opening of St James Quarter in 2021, Princes Street has experienced further decline with many buildings now earmarked for redevelopment into hospitality and entertainment attractions to serve the city's high tourist population.

In common with other centres, diversity in Glasgow is not even, but is more pronounced than the other centres. Glasgow too has experienced a fall in the number of comparison shops over the study period overall, although the downward trend was reversed between 2010 and 2017. However, this reversal is more likely to be linked to the use of stalls and kiosk space in the Savoy centre and other shopping centres being known, whereas in earlier periods these uses could not be classified and were designated as unknown. In the early years, when the retailing sector was growing, the fall in the number of shops in both Glasgow and Edinburgh can partly be explained by small units being merged to create the type of large units demanded by retailers. The redevelopment of Glasgow's Sauchiehall Centre into a smaller number of larger units and the merging of units on Princes Street, Edinburgh and Argyle Street, Glasgow are illustrative of such changes.

As expected, the "Golden Z" (shown in Fig. 4 in yellow), which traditionally has been the prime retail pitch in Glasgow, typically contains the greatest diversity although differential changes occurred across the PRA. On Sauchiehall Street (at the top of the "Golden Z"), diversity increased up to 2010 but then contracted as vacancies increased and stoic planning policy restricted conversion to alternative uses, while diversity peaked on the bottom end of Buchanan Street in 2005 and has since decreased, reflecting growing unevenness in the concentration of national and international comparison retailers at this location. The middle to top end of Buchanan Street is less diverse, mainly due to the unevenness of uses, although a hotspot has formed around the Buchanan Galleries shopping mall. On Argyle Street (at the bottom of the "Golden Z") diversity has increased around St Enoch Square and out towards The Trongate, typically as food and drink and leisure uses have become more established in these locations. The area around the centre of the "Golden Z" (on Gordon Street) has evolved into a richness hotspot, attracting a range of different uses that want to locate close to Buchanan Street without paying the high market rents associated with the prime pitch, although lower relative abundance of different uses has reduced the diversity there.

In Hull the number of comparison shops rose sharply between 2005 and 2010, linked to the St Stephen's Shopping Centre development. Since then, the number of retail units has contracted and diversity has risen, latterly driven by the growth in food and drink outlets and investment by Hull City Council, particularly in museums and entertainment venues, in preparation for City of Culture status. In 2000 and 2005 the greatest diversity was found on the traditional primary frontages: Prospect Street, King Edward Street, Jameson Street, Carr Lane and the top end of Whitefriargate. These are the traditional prime pitches denoted in yellow in Fig. 5. High diversity, even after allowing for the more extensive 'unknown' entries before 2010, seems to have become more dispersed in 2010 and 2017, spreading into the surrounding areas, although a pocket of lower density, largely due to a rise in retail closures, has formed at the top end of Prospect Street, spreading out towards Ferensway. In Hull the vacancy rate has steadily grown to 25.9 % of all known property uses, and is higher than in the other cities. Vacancies were largely former shops and offices in 2010 and 2017, with former offices dominating by 2017. The rise in vacant stores is a common pattern across all centres (with the exception of Edinburgh) which is partly due to growing vacancies in buildings above ground level as retailers and service operators occupying ground floor units have been refusing to take on the liability of this (no longer required) storage space (Orr et al., 2021).

Richness remains greatest on Carr Lane and the junction of Jameson Street/King Edward Street although use diversity has generally fallen with the closure of comparison retailers, including a BHS department store, while St Stephen's Shopping Centre has experienced a rise in richness and diversity as comparison retailers relocated from the

surrounding streets into the mall. The relative abundance of different property uses is more even on some streets neighbouring Jameson Street.

The centre of the primary shopping area in Liverpool, along Bold Street, at the bottom end of Church Street (both forming the traditional prime pitch and shown in yellow in Fig. 6), Whitechapel and the area around Williamson Square, benefitted from relatively high diversity in 2000 and 2005. Table 3 suggests that Liverpool had a high vacancy rate in 2005 but this was, in part, due to units that were vacant, such as in The Metquarter and Liverpool One (both in-town retail and leisure developments), either prior to redevelopment or unlet at completion. Use diversity has remained high as richness has risen around Whitechapel, although there has been a spread westwards with the establishment of Liverpool One at the expense of the periphery of Bold Street that previously had high diversity. The fall in diversity recorded on Bold Street reflecting the clustering in food and drink outlets.¹⁴ The redeveloped Paradise Street also took time to become established.

Nottingham saw the number of comparison shops rise until 2005 but then fall, possibly triggered by the shock of the global financial crisis (GFC) and associated austerity policies, combined with a lack of mall-type development found in some of the other centres. Vacancies were stark, with comparison shops accounting for 59.4 % of all vacant properties in 2010. Diversity appears lower in 2017 than in 2000 and 2005 in Nottingham. Much of the fall has been experienced to the north of Nottingham's primary shopping area, which has seen a growth in vacant units, fast food outlets and charity shops, while the area to south (Clumber Street, High Street and Bridlesmith Gate, shown in yellow in Fig. 7) rose in diversity over the study period. The areas around Trinity Square and Cornerhouse remain diverse, accompanying the establishment and expansion in purpose-built student accommodation through upper floor conversions in this area of the city, but around Long Row there was a dip in 2010. Richness was also lower to the south in and around Broadmarsh but this was compensated for by the relative greater evenness in abundance of different uses.

References

- Allen, S. (2001). Changes in supply chain structure: the impact of expanding consumer choice. In J. F. Eastham, L. Sharples, & S. D. Ball (Eds.), *Food Supply Chain Management: Issues for the Hospitality and Retail Sectors* (pp. 314–323). Oxford: Butterworth-Heinemann.
- Boschma, R. (2015). Towards an evolutionary perspective on regional resilience. *Regional Studies*, 49(5), 733–751.
- Brown, S. (1991). Retail location: The post hierarchical challenge. *International Review of Retail, Distribution and Consumer Research*, 1(3), 367–381.
- Cachinho, H. (2014). Consumerscapes and the resilience assessment of urban retail systems. *Cities*, 36, 131–144.
- Capello, R., Caragliu, A., & Fratesi, U. (2015). Spatial heterogeneity in the costs of the economic crisis in Europe: Are cities sources of regional resilience? *Journal of Economic Geography*, 15(5), 951–972.
- Carmona, M. (2021). The existential crisis of traditional shopping streets: The sun model and the place attraction paradigm. *Journal of Urban Design*. <https://doi.org/10.1080/13574809.2021.1951605>
- Centre for Retail Research. (2021). *Who's gone bust in retailing, 2010-2021*. Available at. London: Centre for Retail Research <https://www.retailresearch.org/whos-gone-bust-retail.html#archive>. (Accessed 29 December 2021).
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, New Jersey: Lawrence Erlbaum Associates.
- Crespo, J., Suires, R., & Vicente, J. (2014). Lock-in or lock-out? How structural properties of knowledge networks affect regional resilience. *Journal of Economic Geography*, 14, 199–219.
- Dabson, A., & McAllister, P. (2014). Evolution and change in the serviced office sector: A decade later. In *Working papers in real estate & planning, working paper 02/14*. Reading: University of Reading.
- Dobson, J. (2015). Britain's town centres: From resilience to transition. *Journal of Urban Regeneration and Renewal*, 8(4), 347–355.

¹⁴ Clustering occurs in cities where a single use dominates and lowers diversity. This may be on part of a street, such as food and drink outlets clustering in Bold Street (Liverpool), or in a small arcade, such as Argyle Arcade (Glasgow) which specialises in jewellery.

- Dolega, L., & Celińska-Janowicz, D. (2015). Retail resilience: A theoretical framework for understanding town centre dynamics. *Studia Regionalne i Lokalne*, 60, 8–31.
- Dopfer, K., Foster, J., & Potts, J. (2004). Micro-meso-macro. *Journal of Evolutionary Economics*, 4(3), 263–279.
- Eckert, A., He, D., & West, D. S. (2013). An empirical examination of clustering and dispersion within Canadian shopping centers. *Journal of Retailing and Consumer Services*, 20, 625–633.
- Ferm, J., Clifford, B., Canelas, P., & Livingstone, N. (2021). Emerging problematics of deregulating the urban: The case of permitted development in England. *Urban Studies*, 58(10), 2040–2058.
- Findlay, A., & Sparks, L. (2010). *Retail vacancy, London: National Retail Planning Forum, briefing paper 13*.
- Findlay, A., & Sparks, L. (2012). Far from the 'Magic of the Mall': Retail (Change) in 'Other Places'. *Scottish Geographical Journal*, 128(1), 24–41.
- GENECON. (2011). *Understanding high street performance department for business, innovation and skills, December 2011*. London: BIS.
- Guy, C. M. (1998). Classification of retail stores and shopping centres: Some methodological issues. *GeoJournal*, 45, 255–264.
- Guy, C. M. (1999). Retail location analysis. In M. Pacione (Ed.), *Applied geography: Principles and practises* (pp. 450–462). London: Routledge.
- Harper Dennis Hobbs. (2014). *Retail Centre reports*. London: Harper Dennis Hobbs.
- Harper Dennis Hobbs. (2017). *Retail Centre reports*. London: Harper Dennis Hobbs.
- Harper Dennis Hobbs. (2019). *Retail Centre reports*. London: Harper Dennis Hobbs.
- Hastings, A., Bailey, N., Bramley, G., & Gannon, M. (2017). Austerity urbanism in England: The 'regressive redistribution' of local government services and the impact on the poor and marginalised. *Environment and Planning A*, 49(4), 2007–2024.
- Hillier Parker. (1996). *Shopping centres of Great Britain: A National Survey of Retailer Representation by trading location*. Hillier Parker May and Rowden.
- Hirschman, H. O. (1945). *National Power and the Structure of Foreign Trade*. Berkeley and Los Angeles, California: University of California Press.
- Hoesli, M., & MacGregor, B. D. (1995). The classification of local property markets in the UK using cluster analysis. In , vol 1. *The cutting edge: proceedings of the RICS property research conference 1995* (pp. 185–204). London: RICS.
- Jackson, C. (2001). A model of spatial patterns across local retail property markets in Great Britain. *Urban Studies*, 38(9), 1445–1471.
- Jones, C., & Livingstone, N. (2018). The 'online high street' or the high street online? The implications for the urban retail hierarchy. *International Review of Retail, Distribution and Consumer Research*, 28(1), 47–63.
- Jost, L. (2006). Entropy and diversity. *Oikos*, 113(2), 363–375.
- MSCI. (2021). *Key centre reference tables: UK (annual) frozen to Dec 2020*. London: MSCI.
- Knight Frank. (2017). *Retail news, issue 7 – The high street: Redundant, relevant or resurgent?* London: Newmark Knight Frank.
- Martin, R. (2012). Regional economic resilience, hysteresis and recessionary shocks. *Journal of Economic Geography*, 12(1), 1–32.
- Martin, R., & Sunley, P. (2015). On the notion of regional economic resilience: Conceptualization and explanation. *Journal of Economic Geography*, 15(1), 1–42.
- Ministry of Housing, C.a. L. G. (2019). *National planning policy framework, 19 February 2019*. London: Ministry of Housing, Communities and Local Government.
- Nyström, M., & Folke, C. (2001). Spatial resilience of coral reefs. *Ecosystems*, 4(5), 406–417. <https://doi.org/10.1007/s10021-001-0019-y>
- OECD. (2022). *UK consumer confidence index (CCI): March 1974 to August 2022, September 2022 release*. Paris: OECD.
- Office for National Statistics. (2021). Retail sales index, 19th November 2021. Available at: <https://www.ons.gov.uk/businessindustryandtrade/retailindustry/datasets/retailsalesindexreferencetables>. (Accessed 12 January 2021).
- Ordnance Survey. (2019). High streets in Great Britain. Mapping the location and characteristics of high streets in Great Britain, working with experimental Ordnance Survey High Street extents and Office for National Statistics data, ONS. Accessible at <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/articles/highstreetsingreatbritain/2019-06-06#quality-and-methodology>.
- Orr, A. M., Stewart, J., & Gardner, A. (2021). *Adaptation in real estate use, ownership and practice: Findings from work packages A and C, REPAIR project working paper 1*. Glasgow: University of Glasgow.
- Orr, A. M., Stewart, J. L., Jackson, C., & White, J. T. (2022). Ownership diversity and fragmentation: A barrier to urban centre resilience. *Environment and Planning B: Urban Analytics and City Science*, 0(0). <https://doi.org/10.1177/23998083221124600>
- PMA. (2021). *UK retail historic time series data: Edinburgh, Glasgow, Hull, Liverpool and Nottingham, Property market analysis, London*.
- Parliament. House of Lords. (2021). *Towns and cities: Local power is the path to recover, HL 2021-2022 (115)*. London: The Stationery Office.
- Peet, R. K. (1974). Measurement of species diversity. *Annual Review of Ecology and Systematics*, 5, 285–307.
- Pennacchioli, D., Coscia, M., Rinzi, S., Giannotti, F., & Pedreschi, D. (2014). The retail market as a complex system. *EPJ Data Science*, 3(33), 1–27.
- Portas, M. (2011). *The Portas review: An independent review into the future of our high streets*. London: Department for Business, Innovation and Skills.
- Ramos-Martin, J. (2003). Empiricism in ecological economics: A perspective from complex systems theory. *Ecological Economics*, 46(3), 387–398.
- Ravenscroft, N. (2000). The vitality and viability of town centres. *Urban Studies*, 37(13), 2533–2549.
- Teale, M. (2012). Attracting investment to the high street. *Journal of Urban Regeneration and Renewal*, 6(2), 154–163.
- Reimers, V., & Clulow, V. (2004). Retail concentration: A comparison of spatial convenience in shopping strips and shopping centres. *Journal of Retailing and Consumer Services*, 11(4), 207–221.
- Reynolds, J., & Schiller, R. (1992). A new classification of shopping centres in Great Britain using multiple branch numbers. *Journal of Property Research*, 9, 122–160.
- Ritsem van Eck, J., & Koomen, E. (2008). Characterising urban concentration and land-use diversity in simulations of future land use. *The Annals of Regional Science*, 42, 123–140.
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.
- Schiller, R., & Jarrett, A. (1985). A ranking of shopping centres using multiple branch numbers. *Land Development Studies*, 2, 53–100.
- Schumpeter, J. A. (1942). The process of creative destruction. *Capitalism, Socialism and Democracy* (pp. 81–86). New York: Routledge.
- Scottish Government. (2014). *National planning framework 3, June 2014*. Available at: Edinburgh: Scottish Government.
- Simpson, E. H. (1949). Measurement of diversity. *Nature*, 163, 688.
- The Town and Country Planning (Use Classes) (Amendment) (England) Regulations. (2020). (SI 2020/757). Available at: <https://www.legislation.gov.uk/2020/757/made>. (Accessed 9 March 2021).
- Thomas, E., Serwick, I., & Swinney, P. (2015). *Urban demographics. Why people live where they do, November 2015*. Available at. London: Centre for Cities <https://www.centreforcities.org/wp-content/uploads/2015/11/15-11-02-Urban-Demographics.pdf>. (Accessed 1 March 2021).
- Tsai, Y. H. (2005). Quantifying urban form: Compactness versus 'sprawl'. *Urban Studies*, 42(1), 141–161.
- URBED, & Comedia. (1994). *Vital and Viable Town Centres: Meeting the challenge*. London: DOE.
- Velázquez, J., Gutiérrez, J., Hernando, A., García-Abril, A., Martín, M. A., & Irastorza, P. (2018). Measuring mosaic diversity based on land use map in the region of Madrid, Spain. *Land Use Policy*, 71, 329–334.
- White, J. T., Hickie, J., Richardson, R., Orr, A. M., & Jackson, C. (2022). The Experience Economic in UK City Centres: a multidimensional and interconnected response to 'death of the high street'? *Urban Studies*. <https://doi.org/10.1177/00420980221143043>. In preparation.
- Wood, S., & McCarthy, D. (2014). The UK food retail 'race for space' and market saturation: A contemporary review. *The International Review of Retail Distribution and Consumer Research*, 24(2), 121–144.
- Wrigley, N., & Dolega, L. (2011). Resilience, fragility, and adaptation: New evidence on the performance of UK high streets during global economic crisis and its policy implications. *Environment and Planning A*, 43(10), 2337–2363.
- Yuo, T. S., Crosby, N., Lizieri, C., & McCann, P. (2004). *Tenant mix variety in regional shopping centres: Some UK empirical analyses, working paper in real estate and planning*. Available at. University of Reading Business School <https://centaur.reading.ac.uk/21650/1/0204.pdf>. (Accessed 7 September 2021).